APPENDIX A

Species Profiles

Part Five: Birds

SPECIES PROFILE

American Bittern

Botaurus lentiginosus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G4
State Rank: S3B
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

American bitterns occupy a range of freshwater wetlands that contain tall emergent vegetation. Suitable habitats thus include cattail (*Typha* sp.) marshes associated with lakeshores, beaver ponds, fens, and impoundments (Gibbs and Melvin 1992, Gibbs et al. 1992, Foss 1994), although nests are occasionally found in hayfields at some distance from water (Foss 1994, R. Andrews personal communication). Because of the species' diet and foraging behavior, it avoids the deeper parts of occupied wetlands (Gibbs et al. 1992). In many parts of the Northeast, bitterns also occur in wetlands dominated by ericaceous or other water-tolerant shrubs (e.g., *Alnus* spp., *Cephalanthus* spp., *Viburnum* spp.) (Gibbs et al. 1991).

Some evidence suggests that bitterns only breed in wetlands above a certain minimum size. In New York and Wisconsin, these minima were 4 and 10 ha (10 and 25 acres) respectively (*in* Gibbs et al. 1992). However, during the New Hampshire Breeding Bird Atlas (BBA) survey, workers reported territorial bitterns from wetlands as small as 1.2 ha (3 ac) (Foss 1994). Such smaller wetlands may serve primarily as alternate foraging sites rather than breeding areas (Gibbs and Melvin 1992).

Bitterns generally use similar freshwater habitats during migration in New Hampshire, although at this time they also occur in salt marshes along the coast (New Hampshire Bird Records). The species has also been recorded in such habitats during the winter months, but is not known to breed in them anywhere in its range (Gibbs et al. 1992).

1.2 Justification

Although bitterns are widespread across the state (see below), there is anecdotal evidence suggesting population decline. This decline is likely a result of wetland loss through draining, filling, and other means. The decline shown by bittern populations in New Hampshire has also been seen on the regional and continental scale, although the pattern of decline is unclear. Statewide atlas accounts in New York (Andrle and Carroll 1988), Vermont (Laughlin and Kibbe 1985), and Massachusetts (Petersen and Meservey 2003) all report on the species' decline since the mid 1990s. It disappeared from Long Island between 1985 and 2000 (New York State Department of Environmental Conservation) and has declined to the point of being listed as Endangered in Connecticut (Gibbs and Melvin 1992). Breeding Bird Survey (BBS) data show a mix of decreases and stable trends in the northeastern portion of the species' range. However, given the patchy nature of bittern habitat and the species' crepuscular behavior, the ability of the BBS to detect real population trends for bitterns is moderate at best, and any trends should be interpreted with caution.

In general, the species is far more common in the northern part of its range, including Canada and perhaps the northernmost portions of New England (Gibbs et al. 1992, Sauer et al. 2004). Data from the Christmas Bird Count (CBC) (National Audubon Society 2002) show a decline in bittern populations in the southeastern United States from the mid 1960s to the early 1990s, after which point numbers have been increasing. It should be noted that bitterns are rarely detected during the CBC, and that these trends in wintering populations may be biased by variation in observer effort or other non-controllable factors.

1.3 Protection and Regulatory Status

See pied-billed grebe.

1.4 Population and Habitat Distribution

American bitterns have probably always been widely distributed throughout New Hampshire. During the BBA, they were reported from 60 blocks (43 priority blocks) (Foss 1994), and the species was present in most of the state except the seacoast and the higher elevations and extensive forests of the White Mountains (figure 1a). More recent data from the breeding season (late April through August, NHBR) indicate that this distribution remains largely unchanged (figure 1b).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

An American bittern habitat model for New Hampshire was modified from a model developed by the USFWS, Gulf of Maine Project (Banner and Schaller 2001). The base map for analysis was a composite wetland map developed at the NHNHB, and NHFG, in which contiguous wetlands were grouped into complexes and given attributes related to wetland size, proportions of different wetland types, and a number of additional variables related to threat and condition (see Marsh and Shrub Wetland habitat profile). Potential bittern habitat was selected from the larger wetland data set using the following criteria ("wetlands" refers to "wetland complexes" as defined in the wetland habitat profile):

- Add +0.5 for wetlands between 1 and 10 hectares (2.5-25 acres)
- Add +1 for wetlands greater than 10 hectares (25 acres)
- Add +1 if emergent vegetation occupies greater than 30% of wetland
- Subtract –0.5 if open water constitutes greater than 50% of wetland (Gibbs et al. 1991)

This model was not tested against known bittern locations in the state, since it is known that the latter data are not comprehensive. There are certainly bittern locations that might not be captured by this model, and many modeled wetlands may not be used by the species. However, the subset of wetlands selected by this model is probably a reasonable representation of the distribution of potential habitat across the state. Exceptions are most likely to occur in the White Mountains and Coastal Lowlands subsections, where bitterns are known to be rare or absent as breeders.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 6. Habitat modeling was informed by the Gulf of Maine Program (Banner and Schaller 2001) and wetland mapping conducted by the NHNHB. Identification of threats, research needs, and conservation strategies was informed by the literature and by regional bird conservation planning (Bird Conservation Region (BCR) 14 and 30 step-downs).

1.8 Extent and Quality of Data

Although bitterns are secretive and thus not as frequently detected as other birds, evidence indicates that the available data do reflect their distribution across the state. However, data on population size and trend are largely non-existent, and the limited available data are acknowledged poor indicators of population status (Sauer et al. 2004).

1.9 Distribution Research

Although the need for distribution information is less critical than for some other wetland birds, accurate population trend data is needed. Given that American bitterns occur with many other wetland birds, any inventory or monitoring program for those species should include American bittern. Surveys should target known or high-potential sites as identified by habitat mapping and should use methods consistent with other efforts in the region. Marsh bird monitoring has been identified as a priority project in BCR 30, and a coordinated regional effort would be invaluable in understanding trends in demographics throughout the northeast.

Element 2: Species/Habitat Condition

2.1 Scale

Given the widespread distribution and varied habitats of the American bittern in New Hampshire, it is difficult to identify an appropriate conservation scale below that of the entire state. In addition, any smaller scale for planning specifically for this species will be severely compromised by a lack of data. It is likely that bitterns occur in numerous wetlands from which we lack verified reports, and as a result it is essentially impossible to accurately evaluate either population or habitat condition at smaller scales. Although the state could be broken into regions based on ecoregions, watersheds, or even counties, wetlands in any such subdivision would not be subject to the same threats or amenable to the same conservation actions. As a result, this profile will consider threats and actions relevant to the American bittern at a statewide scale. Note that individual wetland complexes are being treated by the wetland habitat profile, and much of the information therein will be relevant to bitterns.

2.2 Relative Health of Populations

At the statewide scale, this item has already been addressed in section 1.2 above. Available data do not indicate any local variation of population trends within the state.

2.3 Population Management Status

In the absence of detailed information on management activity at most places where bitterns occur, or on the local effects of management on bittern populations, it is impossible to evaluate management efforts for this species.

2.4 Relative Quality of Habitat Patches

There are no data available with which habitat quality could be evaluated for this species, though the habitat model, which generates scores from 0.5 to 2.0, could be used as a rough approximation of habitat quality on a statewide scale.

2.5 Habitat Patch Protection Status

American bitterns use a variety of wetlands. See Marsh and Shrub Wetland habitat profile for protection status of various wetlands.

2.6 Habitat Management Status

No management specific to American bitterns is in place anywhere in New Hampshire.

2.7 Sources of Information

Data on site occupancy were compiled from NHBR and the New Hampshire BBA (Foss 1994). Information pertaining to management at some bittern sites (state wildlife management areas) was obtained from the NHFG.

2.8 Extent and Quality of Data

In the absence of comprehensive statewide surveys of this species or its habitat, the available data should be viewed as little more than a snapshot of bittern distribution in the state. The available data probably accurately reflect the species range (element 1), but should not be used to evaluate habitat.

2.9 Condition Assessment Research

Little is known about how bittern productivity varies across habitat types, including the effects of patch size and extent of invasive species infestation. Such demographic studies, if conducted in conjunction with distribution and abundance assessments as discussed above, would be valuable in determining the types of wetlands that are most valuable to this species.

Element 3: Species and Habitat Threat Assessment

Key threats identified in form 2 are loss of wetlands to development and the potential for habitat alteration by invasive plants. To the extent that these threats are common to a number of wetland species, they will not be treated in detail here. See the Marsh and Shrub Wetlands habitat profile for more information.

Element 4: Conservation Actions

There are no specific actions for American bittern conservation beyond those identified in the Marsh and Shrub Wetlands profile.

Element 5: References

5.1 Literature

Andrle, R.F., and J.R. Carroll. 1988. The atlas of breeding birds in New York State. Cornell University Press, Ithaca, New York, USA.

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5.2 Data Sources

National Audubon Society 2002. The Christmas Bird Count Historical Results [Online]. http://www.audubon.org/bird/cbc. Accessed 2005 February 8.

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Element 6: List of Figures

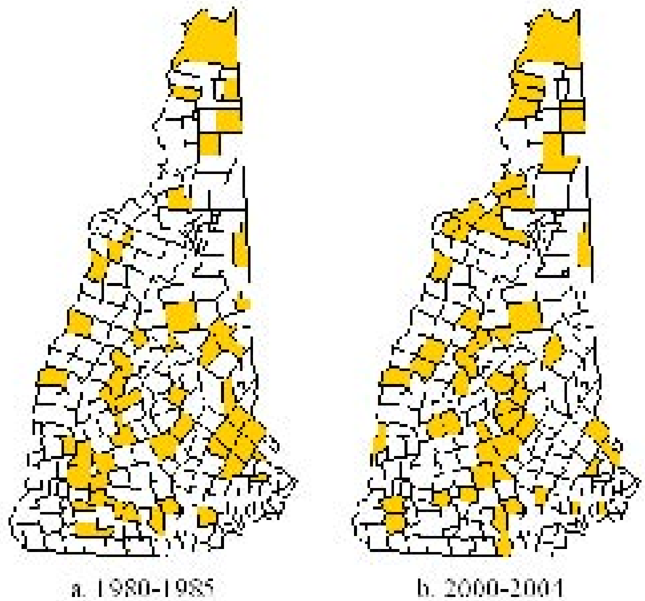

Figure 1. Distribution of breeding season (mid-April through August) records of American bittern in New Hampshire during a) the Breeding Bird Atlas and b) a similar period 20 years later.

SPECIES PROFILE

American Pipit
Anthus rubescens

Federal Listing: Not listed
State Listing: Species of Special Concern
Global Rank: G5
State Rank: S1B
Authors: Celine T. Goulet and Steven G. Fuller, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

American pipit is a ground-dwelling passerine that uses a broad suite of open terrestrial and estuarine habitats (NatureServe 2004). Of these, American pipit breeds in alpine sedge meadow communities dominated by *Carex*, dwarf *Salix*, and *Deschampsia*, and fell fields associated with cushion plants such as *Silene, Trifolium, Phlox,* and *Arenaria* (Verbeek and Hendricks 1994). Eroded turf, tussocks, or tilted rocks are necessary features of nesting habitat, as they provide snow-free nest sites early in the season (DeGraaf and Yamasaki 2001). During the breeding season, American pipit forages in open areas including sedge meadows, felsenmeer, streamsides, and pond margins on south-facing slopes, feeding almost entirely on arthropods, primarily insects (Verbeek and Hendricks 1994).

As weather conditions deteriorate in autumn, American pipit migrates southward throughout the United States and Mexico (Verbeek and Hendricks 1994). Habitats utilized during non-breeding periods include coastal beaches, marshes, mudflats, wet meadows, sandy areas, and cultivated fields, with a preference for mud flats and river courses (Verbeek and Hendricks 1994, DeGraaf and Yamasaki 2001). During migration and the winter, they eat terrestrial and freshwater invertebrates as well as seeds in the fall (Verbeek and Hendricks 1994).

1.2 Justification

American pipit is one of a few species of ground-inhabiting songbirds that breed in alpine habitat (Verbeek and Hendricks 1994). Alpine communities are rare throughout the Northeast, occurring primarily as isolated islands on high peaks. Fragmentation and degradation of these breeding habitats due to recreation, as well as loss of migratory habitat to wetland drainage and farmland reversion, negatively impact American pipit populations (Camfield 2005). In alpine habitats, climate change will induce interdependent changes in the composition, distribution, and phenology of natural communities. In turn, this will increase habitat fragmentation and disrupt migratory patterns, reproduction, and food availability (Halloy and Mark 2003, Lesica and McCune 2004). In response, American pipit populations may become locally extinct (Lesica and McCune 2004, Camfield 2005).

1.3 Protection and Regulatory Status

Protected under the Migratory Bird Act.

1.4 Population and Habitat Distribution

American pipit occurs throughout North America and south to El Salvador (Verbeek and Hendricks 1994). Regionally, its breeding range includes alpine and arctic tundra occurring above treeline between 33° to 78°N at an elevation range of sea level in the north to 4,300 m in the mountains of western United States. The range extends across North America from Alaska to Newfoundland and south in western mountains to California and New Mexico. During the non-breeding season, American pipit migrates to lower altitudes and latitudes, generally avoiding regions with persistent snow cover (Verbeek and Hendricks 1994).

In New Hampshire, this species is rare and irregular during the winter and breeding season, with a small breeding population occurring on Mt. Washington at elevations of 1,650 m to 1,680 m (DeGraaf and Yamasaki 2001). However, during fall and spring migration, American pipit is locally common to very common, especially in major river valleys and along the coast (DeGraaf and Yamasaki 2001). Although the distribution of American pipit sightings have recently expanded in New Hampshire, Christmas Bird Count data indicate a statistically significant decline in populations in all regions (Verbeek and Hendricks 1994, NatureServe 2004). This long-term trend could be related to global warming, urbanization, or habitat loss (Verbeek and Hendricks 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Alpine Habitat profile.

1.7 Sources of Information

Published literature and New Hampshire Natural Heritage Bureau's (NHB) database.

1.8 Extent and Quality of Data

The New Hampshire distribution of American pipit is well documented.

1.9 Distribution Research

Winter ecology of American pipit is poorly understood (NatureServe 2004). More detailed information on winter habitat selection in southern United States and Mexico would be useful in determining areas of high concentration and detecting biologically significant population trends (Verbeek and Hendricks 1994).

Element 5: References

5.1 Literature

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Borror, A.C. 1994. American pipit. Pages 383-384 in C.R. Foss, editor. Breeding bird atlas of New Hampshire. Arcadia, Dover, New Hampshire, USA.

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Hendricks, P. 2003. Spring snow conditions, laying date, and clutch size in an alpine population of American pipits. Journal of Field Ornithology 74: 423-429.

Kimball, K.D., and D.M. Weihrauch. 2000. Alpine vegetation communities and the alpine-treeline ecotone boundary in New England as biomonitors for climate change. USDA Forest Service Proceedings 15(3):93-101.

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Verbeek, N.A., and P. Hendricks. 1994. American Pipit (Anthus rubescens). Pages 1-24 in A. Poole, and F. Gill, editors. The Birds of North America. Volume 95. The Academy of a Natural Sciences, Philadelphia, and The American Ornithologist's Union, Washington, D.C., USA.

Walker, M.D., R.C. Ingersoll, and P.J. Webber. 1995. Effects of interannual climate variation on phenology and growth of two alpine forbs. Ecology 76: 1067-1083.

Walther, G.R., E. Post, P. Convey, A. Menzel, C. Parmesan, T.J. Beebee, J.M. Fromentin, O. Hoegh-Guldberg, and F. Bairlein. 2002. Ecological responses to recent climate change. Nature 416: 389-395.

SPECIES PROFILE

Arctic Tern

Sterna paradisaea

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: SNA
Author: Alina J. Pyzikiewicz, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Arctic terns inhabit rocky coastal islands, coastal beaches, and marshes with ample supplies of fish and crustaceans (Gavutis 1994, Kress and Hall 2004). They breed in rocky, gravelly islands, barrier beaches, gravel bars, and occasionally in marshes and bogs (Hatch 2002). When nesting among other tern species, Arctic terns nest in open ground with little or no vegetation and when nesting with members of the same species, Arctic terns nest in low vegetation (Hatch 2002, Kress and Hall 2004). Arctic terns forage in waters up to 20 km away from breeding colonies where their prey is driven to the surface by predatory marine mammals and fishes, as well as in rocky shores, bays, and tidal flats (Hatch 2002). In winter, Arctic terns inhabit pack ice in open water and near-shore icebergs in the Antarctic Region, feeding in the channels between ice floes and along the edges of pack ice (Hatch 2002).

1.2 Justification

Arctic terns were once frequent nesters on the Isles of Shoals, but the species drastically declined due to an increased demand for tern feathers for the millinery trade in the 1900s and the displacement from preferred nesting habitats by gulls (Kress and Hall 2004). The primary threats to Arctic terns are competition for nesting sites and predation and displacement by gulls (Hatch 2002). This species is of high conservation concern under the North American Waterbird Conservation Plan and Bird Conservation Region 14 (Kushlan et al. 2002).

3.3 Protection and Regulatory Status

The Arctic tern is listed as threatened in New Hampshire and is protected under RSA 212 and the Migratory Bird Treaty Act.

1.4 Population and Habitat Distribution

In North America, the breeding range of Arctic terns extends from the Canadian Arctic down the eastern coastline to Massachusetts. The Gulf of Maine, Nova Scotia, Newfoundland, and the Gulf of St. Lawrence are significant breeding areas (Kress and Hall 2004). Populations of Arctic terns in Bird Conservation Region 14 are estimated at 19,000. In New Hampshire, Arctic terns historically nested on the Isles of Shoals, Seabrook Beach, and several islands in Portsmouth Harbor and Little and Great Bays (Gavutis 1994, Kress and Hall 2004, New Hampshire Bird Records). Since intense gull control was initiated in 1997 on Seavey Island in the Isles of Shoals, Arctic terns have increased. The first pair returned and nested in 2002 and 14 pairs have now nested on the island (New Hampshire Fish and Game (NHFG), unpublished data).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Sources of information include the Breeding Bird Atlas of New Hampshire, Birds of North America, Tern Restoration Handbook, New Hampshire Bird Records, and NHFG and New Hampshire Audubon annual field surveys and reports.

1.8 Extent and Quality of Data

Arctic tern distribution and habitat use are well known in New Hampshire through annual surveys and historical reports. Little is known regarding wintering habitat.

1.9 Distribution Research

Continue to restore Arctic tern populations and monitor productivity on Seavey Island. Continue studying foraging, researching migration routes, and identifying winter habitats and their use.

Element 5: References

5.1 Literature

Gavutis, G. W. 1994. Arctic tern. Pages 378-379 *in* C. R Foss, editor. Breeding bird atlas of New Hampshire. Arcadia, Dover, New Hampshire, USA.

Hatch, J. J. 2002. Arctic tern (Sterna paradisaea). *In* A. Poole and F. Gill, editors. The Birds of North America, No 707. The Birds of North America, Philadelphia, Pennsylvania, USA.

Kress, S. W. and C. S. Hall. 2004. Tern management handbook: Coastal Northeastern United States and Atlantic Canada. National Audubon Society. Ithaca, New York, USA.

5.2 Data Sources

New Hampshire Bird Records. New Hampshire Audubon, Concord, New Hampshire, USA.

SPECIES PROFILE

Bald Eagle

Haliaeetus leucophalus

Federal Listing: Threatened
State Listing: Endangered
Global Rank: G4
State Rank: S1
Author: Christian J. Martin, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Endemic to North America, bald eagles occur widely across the continent in association with aquatic habitats such as lakes, rivers, reservoirs, and coastal estuaries (Buehler 2000). Bald eagles presently have established nests in all of the contiguous United States and in Alaska, as well as in all of the Canadian provinces, and in Mexico's Baja Peninsula. Except for coastal Alaska and parts of northern Canada, where they nest on cliffs or on the ground, eagles nest primarily in forested areas, typically near large water bodies, in mature trees near forest edges, or in super-canopy trees within more uniform forest cover. Distances between nests and water bodies are variable, but are often less than 2 km. Proximity to foraging areas that harbor abundant, diverse, accessible prey may be a more important factor than actual distance from water. Most of the 13 bald eagle nest structures documented in New Hampshire from 1988 to 2004 have been in white pines (77%), although cottonwoods (15%) or red oaks (8%) have also been used.

Populations in different parts of their continent-wide range exhibit variable migratory behaviors, depending on age, breeding status, geographic location of breeding area, and year-round availability of food sources. While territorial on their breeding sites, eagles frequently assemble in higher densities on preferred wintering areas. Such places offer a combination of readily available food and roost sites with good thermal cover and protection from disturbance. Breeding adults from territories in interior Canada typically leave breeding areas for the winter months, while adults breeding in the northern United States often remain on or near breeding territories year-round. Adults breeding in the southern United States raise young during the winter when local weather conditions are more moderate.

1.2 Justification

Bald eagle populations have been closely monitored in the United States since they experienced severe population declines beginning around 1950 (Broley 1958, Buehler 2000). Historical evidence from before European settlement suggests that eagles were abundant across the continent; however, by 1963 only 417 breeding pairs were estimated to remain in the lower 48 states. Some regional breeding populations, especially in eastern and southern states, became locally extirpated. This serious decline led to the designation of the bald eagle as Endangered under the Endangered Species Act. Subsequent research clearly demonstrated that population losses during that period resulted primarily from reproductive failure associated with the presence of high levels of DDT and other persistent organochlorine pesticides in the aquatic food web, which caused severe eggshell thinning and extremely poor hatching success (Wiemeyer et al. 1972, Grier 1982).

Biologists and natural resource managers now recognize that bald eagles can function as useful living barometers or bio-indicators of general environmental quality in aquatic systems because they rapidly accumulate chemical contaminants, such as the organochlorine pesticide DDT and its metabolite DDE, contained in fish.

In New Hampshire, historical records (Allen 1902, Brewster 1925, Dearborn 1898, Scott 1921) from the early 1900s suggest a minimum of about 10 breeding, including some near the following lakes and coastal areas: Connecticut, Newfound, Squam, Umbagog, Wentworth, Winnipesaukee, as well as Great Bay and Hampton Harbor state (Smith 1984). Before eagles were extirpated as a breeding species in the state, New Hampshire's last documented active nest occurred on Umbagog Lake in 1949 (T. Richards, unpublished data). Eagles ceased to breed successfully in New Hampshire by 1950 but continued to occur thereafter in reduced numbers on the state's major rivers and lakes as migrants and during the winter months (Evans 1994). Since 1980, NHA and NHFG have partnered to conduct extensive annual field monitoring of the state's breeding and overwintering eagle population.

1.3 Protection and Regulatory Status

Bald eagles are protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the possession or killing of most non-game birds and the collection of their eggs or nests. They are also protected under the Bald Eagle Protection Act of 1940 (now the Bald and Golden Eagle Protection Act), which prohibits the take, possession, or commerce involving eagles, their body parts, or their eggs. United States populations south of the fortieth parallel were first listed as Endangered by the federal government in 1967 under the Endangered Species Preservation Act of 1966 (Federal Register 32:4001), and this authority was later transferred to the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.). Bald eagles in states north of the fortieth parallel were first protected as federally Endangered in 1978, except in Minnesota, Wisconsin, Michigan, Washington, and Oregon, where they were listed as Threatened (Federal Register 43:6230-6233). The species was first listed as Endangered by the State of New Hampshire in 1979 (R.S.A. 212-A:1 et seq.), and it currently remains classified as Endangered in the state.

Because of significant population recovery throughout much of the United States during the 1980s and 1990s, the species was reclassified in 1995 to Threatened status in all 48 contiguous states (Federal Register 60:35999-36110). In 1999, as a result of continued progress and attainment of regional recovery goals, the United States Fish and Wildlife Service (USFWS) formally proposed delisting the bald eagle throughout the lower 48 states (Federal Register 64: 36454-36464). At the start of 2005, a rule that formally removes the bald eagle from the Endangered Species list has yet to be enacted. As required for any de-listing under the ESA, the USFWS, in cooperation with state wildlife agencies, must develop and implement a post de-listing monitoring plan to track the status of bald eagle populations in the United States for a period of at least 5 years after de-listing.

Other indirect federal protective measures for eagles include those offered by the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136) for new and existing pesticide registration and use, the National Forest Management Act (16 U.S.C. 1600), and the Federal Land Management and Policy Act (43 U.S.C. 1701). Bald eagles are also protected from unregulated international trade by an agreement of the 1975 Convention on International Trade in Endangered Species of Wild Flora and Fauna.

1.4 Population and Habitat Distribution

Following a low point of only 417 breeding pairs estimated present in the lower 48 states in 1963, and subsequent to the banning of DDT in the early 1970s, bald eagle breeding populations have recovered substantially. There were an estimated 1,500 breeding pairs in the contiguous 48 states in 1982 and an estimated 5,300 pairs in the same area in 1997 (derived from data in Buehler 2000). Wintering populations in the continental United States, which include thousands of individuals that breed in Canada, have shown similarly dramatic increases, from an estimated 13,800 individuals in 1982 to an estimated 26,100 individuals in 1997 (Buehler 2000). In the northeastern states, breeding bald eagle population recovery has been led by the states of Maine and New York, which supported 94% of the 459 territorial bald eagle pairs documented in the northeast in 2004 (table 1).

In New Hampshire in 2004, there were 8 breeding territories distributed widely across the state (figure 1), including in the Androscoggin, Connecticut, and Merrimack River watersheds. New Hampshire supported only 1 documented breeding territory from 1988 to 1997, but over the past decade the number of territorial pairs has risen to 8 pairs in 2004 (table 2). From 1988 through 2004, there were 37 active nesting attempts documented in the state, 24 (65%) attempts were successful, resulting in 39 fledglings (1.05 young per active nest). The detailed status of the state's eagle breeding territories is described in table 3.

New Hampshire has participated in the national midwinter survey since 1981 (Steenhof 2002), surveying major wintering areas along the Androscoggin, Connecticut, and Merrimack rivers, as well as the state's Lakes Region and Great Bay/Seacoast area, and other portions of the state where eagles winter in lesser numbers. As shown in table 3, the number of individual eagles documented in the midwinter survey has risen from an average of 8 individuals detected during the 1981 through 1984 surveys, to an average of greater than 43 individuals detected during the 2001 through 2004 surveys. Minimum estimates for the overall number of eagles wintering in New Hampshire during portions of the December-March wintering season have grown from fewer than 20 individuals annually from 1980 to 1983, to greater than 90 individuals from 2001 to 2003 (table 5).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

General natural history information and some sources of original research discussed in this document were obtained primarily from The Birds of North America, No. 506: Bald Eagle (Buehler 2000)). Unless otherwise noted, the source for New Hampshire specific data is field monitoring and management activities conducted by NHA from 1983 to 2004 under annual contracts and/or grants received from the NHFG and/or the USFWS (see Martin 2004a, Martin 2004b, and prior annual reports).

1.8 Extent and Quality of Data

Since the early 1980s, the bald eagle has been one of the most intensively monitored and managed species in New Hampshire. Breeding site data are derived from field monitoring conducted for nearly 2 decades by NHA staff and trained volunteer observers, who employed standardized monitoring techniques to determine nest occupancy and productivity, as well as locations and numbers of individuals present within the state's 5 major wintering areas (Deming 2004, Deming and Martin 2004, Martin 2004b).

1.9 Distribution Research

Future distribution and abundance of bald eagles in New Hampshire should be monitored by conducting spring breeding surveys of known and potential breeding habitat, by participating in the mid-winter counts in the state's 5 major wintering areas, and by site-specific monitoring at important overnight roost sites. Active breeding territories should be checked annually to determine occupancy status and reproductive outcome, and surveys of potential breeding territories should be conducted on a rotating basis, with annual survey intensity determined by funding and human resources available. For example, sites could be checked on a biennial or triennial rotating basis, covering 50% or 33% of potential sites annually. New Hampshire should continue to participate in the national mid-winter bald eagle survey (Steenhof, K., L. et al. 2002). When bald eagles are formally removed from the federal List of Threatened and Endangered Wildlife, New Hampshire should actively participate in the required federal post de-listing monitoring program that will be established by the USFWS.

Element 2: Species Condition

2.1 Scale

Major watersheds will be used as conservation planning units for bald eagle breeding and wintering habitat due to differences in the physical characteristics, human population density, and human land use patterns associated with each major watershed.

2.2 Relative Health of Populations

All of New Hampshire's 11 recently documented occupied breeding territories through 2004 are listed in table 3. All sites listed are associated with a large lake, reservoir, or major river. Of the 11 territories documented, 8 (73%) have been occupied for more than one year, and 7 (64%) have produced fledglings.

Bioaccumulation of chemical contaminants is a major concern in high trophic-level predators, such as bald eagles (Dominguez et al. 2003, Evers 2005, Welch 1994). Although preliminary and with minimal sample size to date, cooperative studies have begun to assess mercury levels in New Hampshire bald eagle nestlings. Although 2004 data is not included here, sampling was expanded in 2004 to include 1 additional study site (Nubanusit Lake) and 7 additional individuals.

2.3 Population Management Status

Ongoing management strategies for bald eagles in New Hampshire fall into 4 main categories:

(1) Locate territorial pairs
From 1988 to 2004, NHA biologists solicited and evaluated public reports of bald eagles in areas of potential breeding habitat and followed up with field surveys to identify occupied territories. Over the past decade, this survey activity has resulted in detection of 1 new breeding pair roughly every 1 to 2 years.

(2) Monitor and manage nesting attempts and wintering areas
Nesting attempts were monitored by trained volunteers observers and NHA staff biologists from 1988 to 2004, which resulted in the documentation of 56 occupied territory-years, 37 nesting attempt-years, 39 young fledged (1.05 young/nesting attempt), and 13 nest failures (35% failure rate). Monitoring also facilitated efforts by the USFWS, NHA, and BioDiversity Research Institute to examine and color band 56% (22 out of 39) of all fledglings produced in the state from 1988 to 2004. The NHA staff installed sheet metal predator guards around the bases of nest trees to deter tree-climbing mammalian nest predators, and NHA staff and trained volunteers also monitor numbers and distribution of bald eagles in winter foraging and roosting areas.

(3) Manage human activity at breeding and wintering sites
Acting under the guidance of NHFG and the USFWS, NHA biologists evaluated potential negative impacts of human recreation on nesting sites and implemented temporary closures when appropriate. In situations where the volume of boating or pedestrian activity threatens to jeopardize the nesting attempt, land-based or floating signs have been placed to create a buffer zone around the nest area. The NHA staff assists NHFG personnel with implementation of appropriate closures and landowner outreach strategies at important winter roost sites.

(4) Public outreach and education
Disseminating information on the goals, objectives, and status of bald eagle conservation efforts in New Hampshire has occurred in a variety of ways and has involved many different target audiences. Extensive efforts have been made to educate the public on accurate identification and reporting of bald eagles. Articles and media news releases on the state's bald eagle recovery efforts and opportunities for direct public volunteer involvement appear annually in newspapers, on radio, and in newsletters of various natural resource agencies and conservation groups. The NHA staff offers public lectures and conduct volunteer training sessions annually to encourage effective public participation in bald eagle conservation. Outreach to landowners, developers, and others concerning bald eagle habitat needs are ongoing and essential.

2.4 Relative Quality of Habitat Patches

Currently occupied breeding habitat appears to provide the key ecological attributes required to support a healthy, expanding breeding population. Large lakes, reservoirs, and ice-free areas below dams will likely provide habitat for additional breeding pairs over the coming decade. Bald eagles are generalist feeders; in addition to fish, they feed on aquatic mammals, waterfowl and gulls, and often carrion. Suitable nesting substrate does not appear to be a limiting factor, except perhaps in the Connecticut Lakes area where there are very few super-canopy pines available. The greatest ongoing habitat quality concerns include the following:

- Additional shoreline development on rivers and large lakes, especially in the Merrimack River watershed and Lakes Region areas
- Increasing use of powerful motorized watercraft and growing popularity of kayaks and canoes, especially in the lakes Region and in the Androscoggin River watershed
- Growing pedestrian use in the winter months near wintering sites along the Merrimack River and in the Lakes Region

- Increasing concerns about mercury and other contaminants, especially in the Merrimack River watershed and in the Great Bay/Seacoast area

2.5 Habitat Patch Protection Status

Of the 8 bald eagle nest sites active in 2004, 4 (50%) were located on public lands (2 federal, 1 state, 1 municipal), while the other 4 (50%) were located on private lands. One of the 4 sites on private land was subject to a conservation easement. Only a few of the state's winter roost sites are on protected land.

2.6 Habitat Management Status

Nest sites on public land are managed in a manner that promotes "no activity" buffer zones around nest trees. Nest sites on private land are subject to landowner decisions, but outreach and education with landowners has usually resulted in land use practices that benefit eagles. Formal management of winter roost areas has been a great challenge because so few sites are on protected land.

2.7 Sources of Information

Information on the state's bald eagle population and habitat is derived directly from summary reports and field data on monitoring and management activities conducted by NHA from 1983 to 2004 under annual contracts and grants received from the NHFG and the USFWS (Deming 2004, Martin 2004a, Martin 2004b).

2.8 Extent and Quality of Data

Because bald eagles have been listed as endangered or threatened on both federal and state lists for much of the past 4 decades, few New Hampshire wildlife species have a more complete data set on occurrence, productivity, and habitat condition. Annual summaries of this information are on file at NHFG.

2.9 Condition Ranking

2.10 Condition Assessment Research

Long-term baseline monitoring of bald eagle breeding and overwintering sites in New Hampshire remains an important task in order to detect any future threats to a stable or growing population. Creation and formal adoption of a state recovery plan that includes specific targets for reclassification to threatened status and for de-listing should be a priority. Analyses of the contaminant loads present in New Hampshire bald eagle chicks should be encouraged and facilitated by NHFG in order to determine the potential effect on statewide productivity and population recovery. Fieldwork, conducted by NHA and others, designed to detect and identify banded individuals should be directly supported by NHFG because the existence of an individually marked population in northern New England offers a unique opportunity to obtain critically important and hard-to-acquire data on dispersal patterns and population demography, individual longevity, and nest site fidelity.

Element 3: Species and Habitat Threat Assessment

3.1.1 Non-Point Source Pollution (Heavy Metals)

(A) Exposure Pathway
Bald eagles are subject to lead poisoning by consuming lead shot or lead sinkers contained within prey or carrion that they consume (Kramer and Redig 1997). Continued use of lead shot or fishing tackle (in violation of state laws) would threaten eagles in these areas. Physical or biological mechanisms in lakes and reservoirs that would bring long-buried lead back to the surface would also threaten eagles.

(B) Evidence
Lead poisoning of bald eagles has been reported from at least 34 states (Buehler 2000). In New Hampshire, a 10-year old founding member of the first breeding pair to become established in the state in the post-DDT era was killed when it consumed lead shot during its 1994 breeding attempt.

3.1.2 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
Shoreline development affects nesting, perching, roosting, and foraging by eagles, with direct and indirect effects on reproductive success and suitability of overwintering areas (Buehler 2000). Development

can limit the future expansion of a recovering population and act to reduce future carrying capacity of areas that currently support eagles (Fraser et al. 1996). New Hampshire is among the fastest growing states in the northeastern United States, and shoreline real estate is under intense development pressure in a relatively lightly regulated environment.

(B) Evidence
Many studies over the past 3 decades have demonstrated that bald eagles prefer to avoid human-developed areas for nesting, perching and roosting. Development brings the secondary problems of increased pollution, pedestrian use, and water-based recreational activities that deter eagle use of otherwise suitable habitat.

3.1.3 Recreation (Boats)

(A) Exposure Pathway
Many studies have found that recreational boating activities can modify foraging patterns of bald eagles by reducing or precluding use of foraging areas, potentially with long-term effects on productivity (McGarigal et al. 1991).

(B) Evidence
Motorized boat traffic on New Hampshire water bodies is increasing, as are the size of vessels and their top speed. Creation of additional access points to public waters in the form of boat ramps, while desirable to the public, has the potential to add to the disturbance problem by increasing the number of boats on the water. The growing popularity of small personal watercraft (motorized jet skis as well as self-propelled canoes and kayaks) has the added effect of bringing increased human traffic into shallow coves and other areas where eagles perch, feed, and rest.

3.1.4 Non-Point Source Pollution (Chemical Contaminants)

(A) Exposure Pathway
Many types of pollutants bioaccumulate in animal tissue and to biomagnify as they reach higher trophic levels, such as bald eagles. While only infrequently resulting in direct mortalities, these pollutants have a range of more common sub-lethal effects, especially in long-lived predators such as eagles that accumulate toxins over a long period. These various neurotoxins produce reproductive, behavioral, neurological, and physiological changes that can result in reduced vigor and breeding success (Dominguez et al 2003, Evers 2005).

(B) Evidence
Brominated fire retardants, commonly known as PBDEs, are similar in chemical structure to PCBs. They are used in a wide range of synthetic household and consumer products. PBDEs have recently been shown to accumulate in wildlife populations worldwide, including in raptors.

3.1.5 Mercury

(A)Exposure Pathway
Mercury bioaccumulates in animal tissues and can reach high levels in piscivorous birds. At low doses, sub-lethal effects on birds include reproductive and developmental abnormalities; at higher doses, adults suffer broader behavioral deterioration.

(B)Evidence
Mercury levels are high and pervasive in northeastern North America, not only in aquatic food webs, but in terrestrial systems as well (Wiemeyer et al. 1972, Welch 1994, Evers 2005). Major sources of atmospheric mercury include coal-fired power plants and medical, industrial, and municipal incinerators. Mercury that makes its way into water can combine with carbon, forming compounds such as methylmercury that are more readily taken up by animals.

3.2 Sources of Information

Information on various threats to bald eagles was obtained from literature review, from NHA field data, and from consultation with specialists employed by the USFWS, NHFG, and NHA, all located in Concord, New Hampshire, and from BioDiversity Research Institute located in Gorham, Maine.

3.3 Extent and Quality of Data

Most of the threats described above have been examined carefully be researchers working outside of

New Hampshire. There are sufficient data on the lead threat in New Hampshire that legislation has recently been passed that prohibits the use of certain size lead sinkers and jigs. Other state legislation is pending. On the threat posed by shoreline development, there is sufficient concern about habitat loss to justify strengthening land use policies and investing in more land protection efforts by federal and state agencies, and by non-profit conservation groups. The negative effects of mercury, PBDEs, and PCBs on aquatic species are well known and well document by researchers nationwide. The effect of increased boating activity is poorly understood for New Hampshire.

3.4 Threat Assessment Research

There are several areas where additional threat assessment research is warranted, including the following:

- Investigation of the tolerance thresholds of bald eagles for recreational boating activity in the vicinity of nest sites and foraging areas
- Additional investigation on current levels of mercury, PCBEs, DDE, and other bio-accumulative pollutants in New Hampshire eagles
- Investigation into the likely future extent of shoreline development on water bodies in New Hampshire, its potential impact of bald eagle breeding and wintering areas, and development of a pro-active plan that would better protect wildlife values associated with shorelines.

Element 4: Conservation Actions

4.1.1 Document breeding status and wintering distribution, Restoration and Management

Distribution and abundance of breeding bald eagles should be monitored by spring surveys at active and potential breeding sites to determine occupancy status and reproductive outcome. Monitoring of wintering areas and roost sites is especially important in areas with high development pressure. Direct threats addressed under this conservation action include shoreline development and increased watercraft use.

4.1.2 Develop state recovery plan for bald eagles, Regulation and Policy

Develop a formal state recovery plan for bald eagles that includes specific targets for reclassification to threatened status and for de-listing. This conservation action builds on more than 20 years of ongoing management activities to insure population viability and establish clear targets for population recovery and reclassification. Direct threats addressed under this conservation action include lead pollution, shoreline development, increased watercraft use, and mercury, PBDEs, and PCBs contamination.

4.1.3 Determine contaminant loads, Restoration and Management

Conduct more extensive monitoring of contaminant loads present in New Hampshire bald eagle chicks to determine the potential effect of toxics on statewide productivity and population recovery. This conservation action builds on more than 20 years of ongoing management activities to insure population viability and understand the effects of environmental contaminants. Direct threats addressed under this conservation action include mercury, PBDEs, and PCBs contamination.

4.1.4 Manage human activity around breeding and wintering sites, Restoration and Management

Manage the potentially conflicting public values of viable bald eagle habitat and outdoor recreational opportunities in a manner that addresses the reality of increasing recreational use of New Hampshire's lakes and rivers. Minimize effects of frequent boating activity on bald eagle breeding success. This conservation action builds on more than 20 years of ongoing management activities. Direct threats addressed under this conservation action include increased watercraft use.

4.1.5 Develop clearer guidelines and stronger regulations to protect shoreline habitat from habitat conversion through development, and pursue ways to protect such areas directly through acquisition in fee or easement, Regulation and Policy.

Work with state regulatory agencies to determine the likely future extent of shoreline development in New Hampshire, identify areas of high habitat value for bald eagles and their prey, and develop guidelines, regulations, and land conservation mechanisms to protect these key areas. Direct threats addressed under this conservation action include shoreline development.

Element 5: References

5.1 Literature

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5.2 Data Sources

Bald eagle wintering area surveys, winter roost counts, breeding site surveys, and productivity data from 1980-2004, New Hampshire Audubon, Concord, New Hampshire, USA.

Element 6: List of Figures

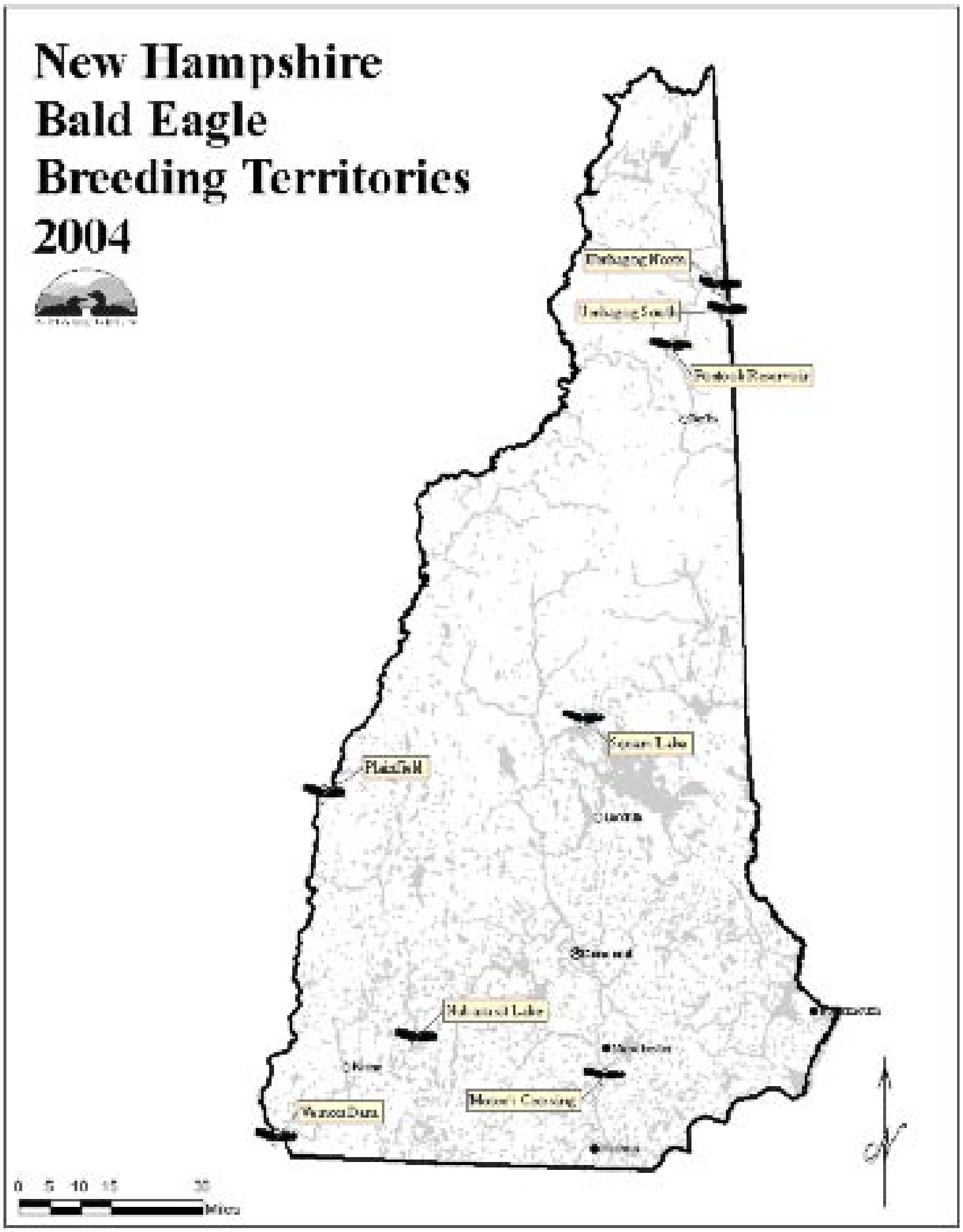

Figure 1. Distribution of bald eagle breeding territories in New Hampshire in 2004.

State	Territorial	Territorial Pairs 2003	Territorial Pairs 2002	Territorial Pairs 2001	# Successful	#	# Young	# Young Fledged 2003	# Young Fledged 2002	# Young Fledged 2001	Source
	Pairs 2004				Pairs 2004		Fledged 2004				
NY	84	75	70	65	66	53	111	87	94	83	P. Nye
VT	0	0	0	0	0	0	0	0	0	0	M. Fowle
NH	8	8	7	8	6	3	11	5	1	6	C. Martin
ME	346	309	290	269	202	190	298	273	280	266	C. Todd
CT	8	8	8	6	4	6	7	10	7	3	J. Victoria
MA	12	15	12	12	13	8	14	13	15	10	T. French
RI	1	1	0	0	1	1	2	1	0	0	M. Amaral
Total	459	416	387	360	292	261	443	389	397	368	
Total in New England	375	341	317	295	226	208	332	302	303	285	

Table 1. Bald eagle territorial pairs and fledged young in the northeastern United States, 2004, 2003, 2002, and 2001.

Year	Territorial Pairs	Active nests	Successful Young Nests	Fledged	Young per Active Nest
1988	1	0	0	0	
1989	1	1	1	1a	1
1990	1	1	1	2	2
1991	1	1	1	1	1
1992	1	1	1	2a	2
1993	1	1	1	2	2
1994	1	1c	0	0	0
1995	1	1	1	1	1
1996	1	1	1	2	2
1997	1	1	0	0	0
1998	2	1	1	2	1
1999	7	2	1	2	1
2000	6	4c	1c	2c	0.5
2001	8b	5	4	6	1.2
2002	7	4	1	1	0.25
2003	8b	5	3	4d	0.8
2004	8b	7b	6b	11b	1.57
Totals for 1988-2004	56	37	24	39	1.05

Table 2. New Hampshire bald eagle productivity summary: 1988-2004.

Breeding Territories (by # years used)	Years Occupied	Years Nesting	Young Fledged	Young / Nesting	Fledged Banded	%Fledged Banded
Umbagog Lake North (1988-2004)	17	14g	16f	1.14	8	50
Nabanusit Lake (1997-2004)	8	6	3	0.5	3	100
Vernon Dam (1999-2004)	6	5	3	0.6	1	33
Pontook Reservoir (1999-2004)	6	4	6	1.5	6	100
Umbagog Lake South (2000-2004)	5	5g	7e	1.4	4	57
Squam Lake (2000-2004)	5	2	2	1	0	0
Moores Crossing (	4	0	0	0	0	0
Ottauquechee River (2003-2004)	2	1	2	2	0	0
Lake Francis (2001)	1	0	0	0	0	0
Surry Mountain Lake (1999)	1	0	0	0	0	0
15-Mile Falls (1999)	1	0	0	0	0	0

Table 3. New Hampshire bald eagle breeding territories: 1988-2004.

Year	Total Eagles	Adults	Immatures	Unknown	Participants
2004	41	27	14	0	55
2003	40	26	14	0	69
2002	50	31	19	0	89
2001	42	28	13	1	58
2000	(no data available)				
1999	35	19	16	0	56
1998	25	15	10	0	39
1997	37	26	11	0	76
1996	33	21	12	0	84
1995	30	16	14	0	94
1994	25	14	11	0	75
1993	21	14	7	0	56
1992	25	20	5	0	50
1991	19	13	6	0	57
1990	19	12	7	0	46
1989	15	9	6	0	42
1988	14	7	7	0	48
1987	9	6	3	0	47
1986	10	7	3	0	31
1985	13	8	5	0	39
1984	12	10	2	0	17
1983	7	5	2	0	17
1982	5	3	2	0	17
1981	8	2	6	0	18

Table 4. New Hampshire mid-winter bald eagle survey results, 1981-2004.

Year	Adults	Sub-ads	Immatures	Totals
2003-2004	57	2	34	93
2002-2003	47	8	37	92
2001-2002	45	12	28	85
2000-2001	29	6	22	57
1999-2000	35	7	16	58
1998-1999	25	7	17	49
1997-1998	32	3	23	58
1996-1997	34	8	32	74
1995-1996	38	5	37	80
1994-1995	37	9	37	83
1993-1994	33	18	19	70
1992-1993	43	5	23	71
1991-1992	38	6	20	64
1990-1991	31	2	20	53
1989-1990	42	8	15	65
1988-1989	39	--	13	52
1987-1988	29	--	27	56
1986-1987	30	--	26	56
1985-1986	40	--	24	64
1984-1985	41	--	29	70
1983-1984	32	--	10	42
1982-1983	9	--	9	18
1981-1982	10	--	6	16
1980-1981	10	--	8	18

Table 5. New Hampshire bald eagle wintering estimates, 1980-1981 through 2003-2004.

SPECIES PROFILE

Bay-Breasted Warbler

Dendroica castanea

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S4B
Author: Jillian R. Kelly, NHFG

Element 1: Distribution and Habitat

1.1 Habitat Description

Bay-breasted warblers use small forest openings, particularly the edges of clearings, bogs, and ponds. They appear to favor vigorous, mature conifers with thick lower branches (MacArthur 1958). In New England, they prefer second growth boreal forest with trees 6 to 10 ft (1.8 to 3.4 m) tall (Pough 1949, DeGraaf and Yamasaki 2001). Bay-breasted warblers have been known to breed at elevations up to 4,000 ft in coniferous or mixed woods in New Hampshire (Andrews in Foss 1994). Bay-breasted warblers forage primarily among the interior branches in the middle section of conifers and often experience population fluctuations in response to spruce budworm outbreaks.

1.2 Justification

Bay-breasted warblers are a species of concern due to the loss of mature spruce-fir habitat from short rotation harvesting and forest conversion. In the eastern spruce hardwood forest, bay-breasted warblers are considered a priority bird species indicative of forest health. According to BCR trend data, bay-breasted warblers are decreasing by 1.4% annually, and in New Hampshire there is a suspected decrease of 6.6% (Hunt 2005). Over a 20-year period, Breeding Bird Survey (BBS) data documented a 77.1% decline of the bay-breasted warbler population in the Northeast (NatureServe 2005). Reasons for bay-breasted warbler decline may include reduced foraging opportunity due to the suppression of spruce budworm, forest fragmentation, large-scale clear cutting, loss of wintering habitat (tropical deforestation) and climate change (Pearson 1996).

1.3 Protection and Regulatory Status

The bay breasted warbler is a BCR 14 priority bird species (Highest concern), and a PIF (physiographic area 28) priority bird species.

1.4 Population and Habitat Distribution

Bay-breasted warblers were once the most common bird in virgin spruce forests at East Inlet, Pittsburg (Andrews 1994) and were considered by some the most abundant warbler at Lake Umbagog (Maynard 1871). In Jefferson, the bay-breasted warbler was considered a “not uncommon summer resident” (Wright 1911). Historic information shows that the species experienced periodic population fluctuations with only few breeding records south of the White Mountains.

Bay-breasted warblers can now be found primarily in the boreal coniferous forests of central and eastern Canada (Pearson 1996). Their breeding distribution in New England is confined to northeast Vermont, northern New Hampshire, and much of central and northern Maine (Andrews 1994). Bay-breasted warbler populations in the Northeastern United States are highly associated with outbreaks of spruce budworm (Andrews 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See High Elevation Spruce-Fir Forest habitat profile.

1.7 Sources of Information

Primary sources of information included DeGraaf and Yamasaki (2001), Hunt (2005), NHFG data, BCR and PIF conservation plans, and Internet sources.

1.8 Extent and Quality of Data

New Hampshire lacks data on the distribution and population trends of bay-breasted warblers. Consistent and comprehensive breeding surveys are needed.

1.9 Distribution Research

New Hampshire needs more consistent data from BBS surveys, research into the effects of spruce budworm control on warbler populations (BCR 14), and research into the effectiveness of maintaining existing patches of mature coniferous trees under current forest management practices (BCR 14).

Element 5: References

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SPECIES PROFILE

Bicknell's Thrush

Catharus bicknelli

Federal listing: Not listed
State listing: Not listed
Global rank: Not ranked
State rank: Not ranked
Author: Laura S. Deming, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Bicknell's thrush occupies balsam fir-dominated forests on high elevation mountain slopes of the northeastern United States and lower elevation forests further north in the Canadian Maritime Provinces. Dense fir thickets typical of breeding habitat have varying amounts of red spruce, black spruce, paper birch, mountain ash, and other species, depending on latitude and elevation.

Within these forests, Bicknell's thrush are most common in areas that undergo frequent natural disturbance from wind, ice storms, fir waves, fire, and insect outbreaks, as well as chronically disturbed high elevation and coastal forests. At high elevations, such areas are most common along exposed ridgelines. This species has also been found in habitats disturbed by humans, such as regenerating timber harvest sites, roads, and ski trails (Rimmer et al. 2001). Occupied habitats are characterized by high numbers of standing dead conifers with a dense understory of balsam fir. In the White Mountains of New Hampshire, occupied sites were dominated by conifers (75% foliage volume) and had a mean canopy height of 4.8 m (15.7 ft) (Sabo 1980 *in* Rimmer et al. 2001). Bicknell's thrushes also prefer a high density of trees, dead fallen trees, snags and stumps, and moss ground cover (Connolly 2000).

In the Catskills, which lie at the southern end of the range, breeding habitat is found above 1,100 m (3,600 ft). In Maine, territories occur as low as 750 m (2,460 ft), and in southern Quebec and New Brunswick, where Bicknell's thrush reaches the northern edge of its breeding range, territories occur in coastal spruce-fir habitat, as well as in regenerating stands of mixed forests above 450 m (1,476 ft) (Rimmer et al. 2001). In New Hampshire, the Bicknell's thrush is found primarily in the White Mountains, between 1,070 and 1,370 m (3,500 to 4,500 ft) in elevation (Richards 1994).

1.2 Justification

Bicknell's thrush breeding habitat is relatively limited, consisting of a series of "islands" throughout the range. High elevation forests are especially vulnerable to degradation from global climate change, atmospheric pollution, and human disturbance caused by construction and maintenance of ski areas, cell towers, wind farms, and roads, as well as hikers, mountain bikers and other recreational users.

On its wintering grounds, this species occupies moist, primarily broadleaf forests, which have been severely reduced (Rimmer et al. 2001). The Dominican Republic has lost about 90% of its forest habitat, Jamaica has lost 75%, Cuba has lost 80-85%, and Haiti's forests are all but gone, with less than 1.5% remaining (Stattersfield et al. 1998). Bicknell's thrush was found at 7 of 11 surveyed historic sites (14 sites known) in 1995-97, and several sites had been degraded to the point of being unsuitable for this species (Rimmer et al. 2001).

Atlas projects in northern New England and New York indicate that Bicknell's thrush still occupies most of its historic breeding range. In New York, atlas maps of Bicknell's reports were very similar to locations reported by Bull in 1974, and no changes in distribution or abundance have been documented over the past century (Peterson 1988). In Vermont, this species has probably never been widely distributed, being limited to the small number of peaks above 914 m (3,000 ft) along the spine of the Green Mountains (Kibbe 1985). Bicknell's thrush was known to occur historically on Mt. Greylock (Massachusetts) as early as 1888, but the small breeding population (6-11 pairs from 1934-60) began to decline in 1960, and the species was considered extirpated from the state by 1973 (Veit and Petersen 1993).

In Maine, Bicknell's were documented on several peaks in western Maine, and on Mt. Katahdin in central Maine (Adamus 1983). However, there are about 150 peaks rising above 750 m (2,460 ft) in western and central Maine, and it is likely that many of these support Bicknell's thrush. Most of these peaks are remote and lack access via trails or roads, making surveys extremely difficult (Maine Office of GIS).

1.3 Protection and Regulatory Status

The Bicknell's thrush is protected in the United States under the Migratory Bird Treaty Act of 1918.

1.4 Population and Habitat Distribution

In New Hampshire, Bicknell's thrush breeding habitat is centered in the White Mountains, where this species was first recorded during the breeding season in 1882 (Richards 1994). During the early 1950s, they were reported in Dixville Notch, the Third Connecticut Lake (Pittsburg), Mt. Sunapee (Newbury), and Mt. Monadnock (Jaffrey), and Mt. Kearsarge (Warner/Wilmot). A nest with eggs was found on Mt. Kearsarge in 1957, and the species was present on this site from 1950 through 1970 (Richards 1994). In 1970, Bicknell's thrushes were also documented on Mt. Cardigan, in Orange and Alexandria. Over the past few decades, breeding populations on Kearsarge, Monadnock, Sunapee, and Dixville Notch have disappeared, and today, the Bicknell's thrush is almost entirely restricted to the White Mountains, with possible occurrences on Mt. Cardigan and in the North Country (Richards 1994).

The transient and patchy nature of Bicknell's thrush breeding habitat results in erratic distribution of occupied breeding territories. They also exhibit a unique breeding strategy, termed "female-defense polygynandry" (Briskie 1993 in Rimmer et al. 2001), where both males and females pair with more than one partner. In Vermont, more than 75% of broods had multiple paternity, some males had offspring in two nests simultaneously, and 75% of nests had 2-4 males feeding the nestlings (Rimmer et al. 2001). The inaccessible nature of their breeding habitat combined with a rather complex mating system make this species especially difficult to study.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

The Bicknell's thrush habitat map was based on model developed by New Hampshire Fish and Game (NHFG) that integrates three data sets to capture potential breeding habitat. The first, a habitat model developed by the Vermont Institute of Natural Science (VINS), sets an elevation "mask" that drops 81.63 m for every 1 degree increase in latitude to reflect climatic effects on forest composition and structure (Lambert et al. 2004). This ratio is based on the lowest altitudes documented for Bicknell's in the southernmost sites (the Catskills), and the northernmost sites (southern Quebec), and is nearly identical to the ratio for tree line, which drops approximately 83-m/1 degree in elevation (Cogbill and White 1991). Above this mask, VINS used the 1992 National Land Cover Dataset (NLCD) to map softwood cover as potential Bicknell's thrush breeding habitat.

A second model designed to predict Bicknell's thrush distribution and abundance in the White Mountains used satellite imagery of land cover, digital elevation model, and point count data (Hale in press). This model was accurate in predicting Bicknell's distribution within a decile range of 0.10-0.60, but overestimated the number of birds above 0.60 deciles, which tended to occur at pixels in krummholz and in the alpine zone. This model also included lower elevation forests with high hardwood component, which support much lower densities of Bicknell's (Rimmer et al. 2001). However, because the area of this lower elevation habitat is so extensive, it has the potential to support a greater number of birds than the smaller area of higher elevation habitat.

In addition to these two models, NHFG also used NHNHB data on four high elevation communities to ensure that as much high elevation softwood habitat as possible would be included as potential habitat.

1.7 Sources of Information

Information on historic and recent Bicknell's thrush distribution and habitat was found in breeding bird atlases from New York, Vermont, and New Hampshire, and from the Bicknell's thrush account of the Birds of North America series. Habitat models developed by VINS and S. Hale were combined with NHNHB data in the mapping effort by NHFG. Data on Bicknell's thrush occurrences were derived from monitoring data gathered by Mountain Bird Watch (VINS) and the WMNF monitoring program from 1992 to 2000.

1.8 Extent and Quality of Data

Despite the quantity of data generated by the above-mentioned monitoring programs, a substantial portion of the Bicknell's range is inadequately surveyed, and there is incomplete information on their distribution, relative abundance, breeding success, and other population parameters. Due to the remoteness and inaccessibility of their breeding habitat and unique breeding strategy, Bicknell's thrushes are difficult to survey. Breeding Bird Survey (BBS) routes do not typically represent high elevation spruce fir habitat, and not surprisingly, Bicknell's are rarely reported on BBS routes (Sauer et al. 2003). The data gathered so far are not enough to determine significant trends in populations over recent years.

1.9 Distribution Research

The Mountain Birdwatch Program instituted by VINS in 2000 is the most comprehensive approach to determining the distribution of Bicknell's thrush throughout its range in the Northeast. In 2003, this program covered 117 routes throughout New York, Vermont, New Hampshire, and Maine, yet many potential breeding areas are too remote and inaccessible to be surveyed, particularly in northern New Hampshire and west-central Maine. Based on elevation data from the Maine Office of GIS, there are approximately 150 peaks above 750 m (2,460 ft) in Maine, all of which could provide suitable habitat for Bicknell's thrush. These inaccessible mountains would need to be surveyed in order to fully determine the actual extent of the breeding range.

Element 2: Species Condition

2.1 Scale

Based on habitat mapping of high elevation spruce fir habitat conducted by NHFG, 24 units were identified as potential or known habitat. The largest area (approximately 39,000 ha) is on the WMNF, and includes 10 of the units. Another 11 units are located north of the White Mountains, two of which (Nash Stream and Bunnell Preserve) are listed separately because they are conservation lands. The units are grouped according to similarities in their ownership and/or conservation status:

- **North Country:** NHFG WMA North; Lyme Timber; NHFG Natural Area; Magalloway Mt.-Stubb Hill; Crystal Mt.-Blue Ridge; Mt. Dustan; Sanguinary-Rice Mts.; Dixville Peak-Mt. Kelsey; Cambridge
- **North Country west:** Nash Stream; Bunnell Preserve
- **Success:** Mahoosuc Range
- **WMNF:** Pilot-Kilkenny-Pliny Range; Wildcat Mt.; Mt. Washington; Pemi Wilderness; Franconia Ridge-Twin Mt.; Kinsman Ridge; Osceola-Kancamagus; Sawyer Pond-Bear-Moat Mts.; Moosilauke; Cushman-Carr Mts.
- **West Central:** Smarts Mt.; Mt. Cardigan

2.2 Relative Health of Populations

There is no information on the relative health of Bicknell's populations in New Hampshire. Bicknell's thrushes are known to breed throughout most of their historic range in the state, with the exception of the most southern locations, although most of the potential habitat north of the White Mountains is inadequately covered.

Relative abundance of Bicknell's thrush appears to be unchanged from 2000 to 2003, based on Mountain Birdwatch data (Lambert 2003). However, surveys from 1992 to 2000 by VINS and WMNF showed that this species may possibly have increased slightly in Vermont and declined somewhat in New Hampshire (Rimmer et al. 2001). In general, the amount of data collected cover too brief a time to allow detection of significant population changes.

2.3 Population Management Status

Bicknell's thrush populations are not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

Nearly all of the peaks above a threshold elevation of 915 m (3,000 ft) in New Hampshire (Hale 2001) have habitat suitable for Bicknell's thrush, all of which are threatened by atmospheric deposition of acidic compounds, heavy metals, and other pollutants. Peaks in the White Mountains have several ski areas, and thousands of miles of trails that attract millions of visitors each year, making them vulnerable to recreation impacts. An assessment of habitat quality for different patches should include size of habitat block, forest stand characteristics, natural and human disturbance factors, and measures of ecosystem health that could include invertebrate community, soil toxicology, and other factors. Habitat condition should be correlated with Bicknell's thrush population parameters, including mortality rates, blood mercury content, etc.

2.5 Habitat Patch Protection Status

Bicknell's thrush habitat in the northeastern United States is mostly protected by national and state forests. Of the 111,346 ha of potential Bicknell's thrush breeding habitat identified by the VINS GIS model, 90,190 ha 81% is on conservation lands (Lambert 2003). New Hampshire and New York contain the majority of potential Bicknell's thrush habitat (45% and 24%, respectively), and have the highest percentages on protected lands (94% and 93%, respectively). Vermont, which has 8% of the breeding habitat, has 83% on conservation lands, and Maine, with 23% of the habitat, has just 41% on conservation lands (Lambert 2003).

In New Hampshire, approximately 83% of Bicknell's thrush habitat is on the WMNF, about 5% is on state forestlands, and the remainder (about 12%) is protected by private conservation lands, forest preserves, town forests, and timberland easements (Lambert 2003).

2.6 Habitat Management Status

See section 2.5. Habitat is not managed specifically for Bicknell's thrushes in New Hampshire, but populations may indirectly benefit from other management activity on state and federal conservation land.

2.7 Sources of Information

Most information on Bicknell's thrush breeding range, habitat, and conservation status, as well as extent and conservation status of potential breeding habitat was derived from documents and reports produced by VINS. Supplemental information was gathered from breeding bird atlases for the region. Population data were generated by the WMNF high elevation bird surveys and VINS Mountain Birdwatch surveys. Habitat models were developed by VINS and by Dr. Stephen Hale of the University of New Hampshire.

2.8 Extent and Quality of Data

Data on presence and relative abundance of Bicknell's thrush have been gathered by VINS and WMNF for several years, but not long enough to determine statistically significant population trends. The core breeding range continues to be monitored by the Mountain Birdwatch Program (VINS), but many more remote peaks are still not monitored at all. There is very little information on the effects pollution and other impacts on the breeding habitat.

2.9 Condition Ranking

2.10 Condition Assessment Research

The greatest threats to Bicknell's thrush are climate change, atmospheric deposition pollution (e.g., acidic compounds and mercury), and destruction of wintering habitats. To address issues threatening Bicknell's on their breeding grounds, research efforts should focus on determining the effects of pollutants and climate change on Bicknell's thrush as a component of the overall high elevation ecosystem.

Element 3: Species and Habitat Threat Assessment

3.1 Threats

See Form 1: Threat Identification, Form 2: Threat Ranking, and Form 3: Local Threat Weighting (attached). Form 4 (Feasibility Ranking) for Bicknell's thrush will be inextricably linked to the Feasibility Ranking for high elevation spruce-fir and for non-breeding birds. All threats to Bicknell's in New Hampshire are related to either habitat degradation or broader threats such as climate change and acid deposition.

Considerable evidence suggests that habitat loss on the Caribbean winter grounds may be the most critical threat facing Bicknell's thrush. New Hampshire should thus work cooperatively with other northeastern States and Provinces in developing a feasible and effective habitat conservation program in the Dominican Republic (where the majority of the population is believed to winter). Although few Bicknell's have been recorded in Haiti, Jamaica, Puerto Rico, and Cuba, this may be partly because these countries have so little of their original forested habitat remaining. International initiatives should consider these countries potential partners in any activities related to Bicknell's thrush conservation.

3.1.1 Acid Deposition

High elevation spruce fir forests throughout the Northeast have been affected by acid deposition. Acidification has resulted in extensive die-offs of red-spruce, which is not the dominant species in Bicknell's thrush breeding habitat, but makes up a large component of forest composition. Acidification also leaches calcium from the soil, causing declines in tree health, invertebrate prey quality, and ultimately reducing fitness in Bicknell's and other insectivorous vertebrates.

3.1.2 Mercury

Atmospheric deposition of pollutants such as mercury and lead may affect high elevation forests and wildlife. Methylmercury can accumulate in the food chain and pose a risk to insectivorous species such as Bicknell's thrush.

3.1.3 Climate Change

High elevation spruce fir forests and associated wildlife will likely decline as the climate changes and temperatures become too warm for the species to survive or compete with other warm-adapted species. One estimate indicates that a 3° rise in the mean July temperature could result in an 88% to 98% loss of the United States breeding habitat of Bicknell's, including extirpation from the Catskills, southern Adirondacks, Green Mountains, western Maine, and possibly up to 144 mountains in New Hampshire (Lambert and McFarland 2004).

3.2 Sources of Information

Threats information for Bicknell's thrush was derived from the literature and discussions with experts and colleagues during threat identification and ranking meetings. For Bicknell's thrush, the threats forms for high elevation spruce-fir habitat were used and modified as appropriate to address threats to this particular species.

3.3 Extent and Quality of Data

There is substantial information on the effects of forest practices and other habitat conversion (ski area expansion, roads, etc) on forest birds such as Bicknell's thrush. A great deal of research on the effects of acid rain on spruce-fir forests has also been done, although the direct impacts on Bicknell's and other species are not well documented. Less is known about other impacts, including pollutants, wind and cell towers, and recreation impacts.

3.4 Threat Assessment Research

There is little or no data on the effects of pollutants on Bicknell's thrush, but atmospheric deposition of mercury is likely to be a major threat to this species. Also, there is very little known about the effects of recreation along hiking trails and ski trails, nor the impact of developments at high elevation.

Element 4: Conservation Actions

See Element 4 for High elevation spruce-fir and Non-breeding birds.

Element 5: References

5.1 Literature

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5.2 Data Sources

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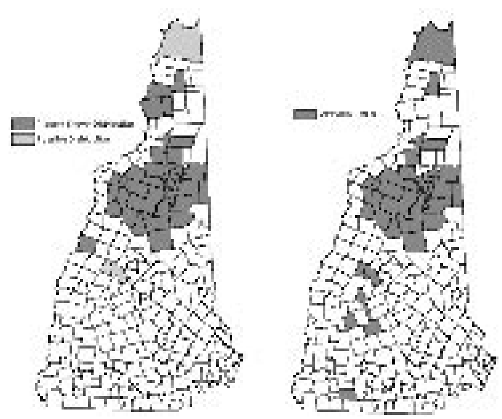
White Mountain National Forest Breeding Birds Surveys. White Mountain National Forest (WMNF), Laconia, NH.

Element 6: List of Figures:

Figure 1. Historic (up to mid-1950's) and present distribution of Bicknell's thrush during the breeding season. Towns are coded as known (dark gray) or possible (light gray) sites for Bicknell's thrush.



SPECIES PROFILE

American Black Duck

Anas rubripes

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S4
Author: New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

American black duck breeding habitat includes a variety of coastal and freshwater habitats, including brackish marshes, estuaries, river, lake, and pond edges, forested swamps, bogs, beaver ponds, emergent wetlands, and open boreal and mixed hardwood forests. Nests are usually laid on the ground and may be a mile from water. Wintering habitat includes brackish marshes bordering bay, estuaries, and open water areas on freshwater rivers and ponds (DeGraaf and Yamasaki 2001).

The black duck diet varies greatly with habitat. In marine habitats, black ducks feed primarily on mollusks, and in fresh water they feed mostly on aquatic plants. Ducklings and egg-laying females consume significant quantities of protein. Other foods include seeds, acorns, berries, waste corn, crustaceans, and amphibians.

1.2 Justification

Mid-winter black duck surveys indicated that populations were stable over the last 20 years, though wintering black duck numbers have declined dramatically both in total and in the Atlantic Flyway from population numbers in the 1950s (USFWS 2004). The American black duck was ranked as the highest conservation concern (HH) for both Bird Conservation Regions (BCR) 14 and 30 and ranked high Regional priority (rank = 3). The black duck is the most important harvested duck in Canada and is considered a trophy species in the United States. The black duck was once the most common duck in New Hampshire (Lacaillade 1975), though since 1991 is has been only the third most abundant puddle duck harvested (NHFG duck kill unpublished data).

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act (1918): listed as game bird
- Federal trust species for the USFWS, United States Department of the Interior, through 50 CFR Part 20, establishes frameworks for migratory bird hunting regulations.
- NHFG, in accordance with RSA 209:6, establishes annual New Hampshire waterfowl hunting seasons in compliance with federal frameworks.

See Marsh and Shrub Wetlands and Salt Marshes habitat profiles for habitat-based regulations.

1.4 Population and Habitat Distribution

Black ducks breed from Northern Saskatchewan across Canada east to Northern Labrador and Newfoundland and south to northern Illinois and North Carolina. Wintering populations are found primarily along the Atlantic Coast from New England south to North Carolina but occur as far south as Florida and west to Texas. In New Hampshire, black ducks are found throughout the state and are the third most commonly breeding duck species in the state (Northeast Breeding Plot Survey 2004, unpublished data). Black ducks winter primarily in coastal salt marshes and on Great Bay and are the most common winter puddle duck in coastal marshes (MWS 2005, unpublished data). During spring and fall migration, black ducks are observed statewide but are most common in coastal areas.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

Not completed for this species; See Marsh and Shrub Wetlands and Salt Marshes habitat profiles

1.7 Sources of Information

Information on American black ducks was collected from the North American Waterfowl Management Plan (NAWMP), The Atlantic Coast Joint Venture (ACJV) Plan, Long-term Eastern Waterfowl Survey, the federally coordinated Mid-Winter Waterfowl Survey, the Atlas of Breeding Birds in New Hampshire, NHFG survey data, Waterfowl and Their Management in New Hampshire, Atlantic Flyway Waterfowl Harvest and Population Survey data, The American Black Duck Symposium publication, and personal knowledge of the NHFG Waterfowl Biologist.

1.8 Extent and Quality of Data

North American waterfowl population and harvest surveys were initiated in 1952. The database pertaining to North American waterfowl species, including the American black duck, is one of the most reliable and extensive wildlife data sets in the world.

1.9 Distribution Research

As part of the North American Waterfowl Population and Harvest data sets, annual breeding, wintering, and harvest surveys are conducted throughout the black duck range to monitor population distribution and abundance. Close cooperation between Canada and the United States to maintain harvest parity and coordinate population surveys is critical to the long-term management of the black duck (Atlantic Flyway Council Technical Section-Black Duck Committee).

Element 2: Species/Habitat Condition

2.1 Scale

Black duck harvest and population monitoring surveys remain an international cooperative venture. Key wintering, breeding, and migratory areas were identified for New Hampshire.

2.2 Relative Health of Populations

The American black duck population in North America and in New Hampshire is considered stable. In response to concerns about the population, flyway harvest restrictions were instituted in the United States in 1983 and in Canada in 1984, and reduced harvest by over 40%. Mid-winter waterfowl survey data indicate that population sizes have remained generally stable during the period of harvest restrictions, and breeding surveys in Canada have shown increases (Kehoe 1990).

Black ducks are the fourth most common breeding waterfowl species in the State (4,346 breeding pairs) and breed in the highest numbers in northern areas (NHFG Waterfowl Plot Surveys 1993-2004, unpublished data). Great Bay and coastal salt marshes winter an average of 1,385 black ducks annually (NHFG Mid-winter surveys [MWS] 1952-2005, unpublished data). A small number of black ducks, 493 per year on average, winter at inland sites generally in open water areas below dams on rivers (NHFG Inland Winter Survey 1988-2004, unpublished data).

2.3 Population Management Status

The USFWS and the Canadian Wildlife Service (CWS) have jurisdiction over harvest regulations in their respective countries. In the Atlantic Flyway, provinces, federal agencies, and all states cooperatively fund and conduct population monitoring surveys that inform annual North American hunting regulations for the American black duck. State and provincial wildlife agencies establish annual hunting regulations according to frameworks established by the USFWS and CWS within the context of the Flyway system of waterfowl management.

2.4 Relative Quality of Habitat Patches

Not completed for this species. See Marsh and Shrub Wetlands and Salt Marsh Habitat Profiles.

2.5 Habitat Patch Protection Status

The NAWMP (1986) and the subsequent ACJV plan were established to conserve the most important habitats for waterfowl (breeding, migration, and wintering). Each state was asked to identify the most important areas for future protection work. In New Hampshire, 3 waterfowl focus areas were established for to protect habitat for black ducks: Lake Umbagog National Wildlife Refuge (for breeding), Connecticut River Silvio O. Conte National Wildlife Refuge (for migration), and Great Bay National Wildlife Refuge (for wintering).

In all 3 areas, state, federal, and private partnerships provide tens of millions of dollars to protect thousands of acres of waterfowl habitat. In all wetland protection efforts, a minimum 91m (300 ft) wide upland buffer area is also protected to provide nesting habitat for waterfowl.

It is anticipated that significant acquisition of waterfowl habitat will continue in each area. It is also anticipated that the Merrimack River Corridor will be designated as a planning area in a future NAWMP update. The NHFG has protected habitat along the Merrimack River Corridor, and partnerships are being established to conserve thousands of acres of wildlife habitat along the river. The Merrimack River is a significant migration corridor for black ducks and is worthy of a "Planning Status" under the NAWMP. Future efforts will focus on establishing that designation.

2.6 Habitat Management Status

Habitat management and protection in New Hampshire began in the late 1940s. NHFG, in coordination with the Atlantic Flyway Council, began acquiring wetland habitat and constructing low-head water control structures to create and maintain habitat for native waterfowl species, including the American black duck. From the late 1940s through 1983, protection and management of these habitats was made possible by donated property value used to match Federal Aid Pitman-Robertson and Dingal-Johnson monies. In 1983, State legislation was passed which established a State Duck Stamp. Revenues from the sale of $4.00 stamps and associated artwork are placed in a dedicated account for waterfowl management in the state. Today, NHFG owns or manages 49 State Waterfowl Management Areas, which include over 3,557 ha (8,790 ac) of habitat. Thirty of the Department's Wildlife Management Areas include water control structures that allow water level manipulations to stimulate the growth of desirable aquatic plants.

Most waterfowl habitat in New Hampshire is in private ownership and is created and managed primarily by beaver (*Castor canadensis*). A healthy beaver population provides the majority of waterfowl habitat in the state for all life stages, with the exception of wintering habitat, which is primarily salt marsh. Historically, salt marsh habitat was degraded by ditching and draining salt marshes for hay production and mosquito control. Today, Ducks Unlimited, along with the other partners in the Great Bay Resource Protection Partnership (NHA, Great Bay National Estuarine Research Reserve, NHFG, TNC, Society for the Protection of New Hampshire Forests, USEPA, USFWS, and the NRCS) have conducted open water marsh management in a number of salt marsh locations to restore various drainage situations to improve black duck habitat.

2.7 Sources of Information

See element 1.7

2.8 Extent and Quality of Data

See element 1.8

2.9 Distribution Research

See element 1.9

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway

The loss or degradation of wetlands will reduce the number of sites available for breeding, wintering, or migrating American black ducks and other waterfowl. Development of upland buffers can reduce water quality of wetlands, increase disturbance to birds, and eliminate nesting opportunities or increase the disturbance or destruction of nests by humans, pets, or subsidized predators (e.g., raccoons).

(B) Evidence

The major threats to bird populations in the ACJV are habitat loss, fragmentation, and degradation. Along the Atlantic Coast, there has been a 76% increase in the human population from 1950 to 2000 (ACJV Plan). New Hampshire is the fastest developing New England state, and though wetland loss in New Hampshire has been minimal over time (94% of original wetland habitat remains) (NHOSP 1989), the upland edges along marshes, ponds, lakes, and rivers are rapidly being developed (see Marsh and Shrub Wetlands profile-Threats).

3.1.2 Acid Deposition, Non-Point Source Pollution (Runoff and Sedimentation, Chemical Contaminants)

(A) Exposure Pathway
A number of different water quality issues affect the black duck. Acidification of wetland habitats can decrease the amount of invertebrate food required by duckling and egg-laying females (Kehoe 1990). Runoff, including salt, petroleum products, and silt, from increased road development affects water quality, as do fertilizers from lawns that are adjacent to wetlands, lakes, ponds and rivers.

(B) Evidence
Literature on the negative effects of water quality on wildlife is abundant (see Watershed Profiles). At Great Bay, poor water quality because of untreated sewage from coastal treatment plants has resulted in periodic outbreaks of a "wasting disease" that kills eelgrass (*Zostera marina*). Eelgrass is a critical life-cycle component for most fish and wildlife species that use Great Bay (Short 1992).

3.1.3 Predation and Herbivory

(A) Exposure Pathway
Predators, particularly along wetlands where the upland edge has been reduced in size or quality due to development or other causes, can significantly harm eggs, ducklings, and nesting females. Good wetland habitat and upland buffer habitat minimize the effect of predation.

(B) Evidence
In New Hampshire, raccoons, skunks, foxes, coyotes, weasels, mink, snapping turtles, and a variety of hawks and owls prey on ducks and eggs. The raccoon has long been considered the most significant waterfowl predator in New Hampshire, but after the outbreak of raccoon rabies in the 1980s, the raccoon population was substantially reduced. Warm water fish populations, including largemouth bass (*Micropterus salmoides*), pickerel (*Esox* spp.), and northern pike (*Esox lucius*) can kill ducklings.

3.1.4 Scarcity (Hybridization)

(A) Exposure Pathway
Black ducks and mallards readily hybridize throughout the black duck breeding range. As mallards continue to occupy traditional black duck range in eastern Canada and northern New England, the opportunity for hybridization also increases. There is still significant disagreement among waterfowl experts about the extent and seriousness of hybridization by mallards and black ducks. Where mallards occupy black duck habitat, they tend to do so permanently. Mallards are generally significantly more tolerant of people and their associated disturbances and more tolerant of agricultural practices. It is anticipated that as residential development and agricultural operations expand, the mallard will continue to replace the black duck in breeding habitats.

(B) Evidence
In New Hampshire, mallards over the last 30 years have replaced the black duck as the most common breeding and harvest species. In New Hampshire, during the 1999 to 2002 hunting seasons, 4.3% of the total number of mallards and black ducks shot by hunters were classified as hybrids (Serie and Raftovich 2003).

Competition between mallards and black ducks during the winter is considered minimal in New Hampshire. Black ducks winter primarily in coastal habitats and outnumber the mallard 2.2 to 1. Between 1990 and 2005, wintering black ducks and mallards in coastal areas averaged 1,159 and 526 birds per year respectively (MWS 2005, unpublished data). Mallards winter in much larger numbers on open fresh water sites where they outnumber the black duck 9.7 to 1.0. Between 1988 and 2004, an average of 4,533 mallards per year wintered at inland sites, compared to only 439 black ducks (NHFG Inland Winter Survey, unpublished data).

3.2 Sources of Information

Literature reviews, NHFG and Regional waterfowl surveys, and professional experiences.

3.3 Extent and Quality of Data

The database pertaining to North American waterfowl species, including the American black duck, is one of the most reliable and extensive wildlife data sets in the world. The effects of upland and wetland habitat loss are known.

3.4 Threat Assessment Research

None suggested at this time.

Element 4: Conservation Actions

Habitat protection and management as described in elements 2.5 and 2.6 are priorities. For other habitat-based actions, see Marsh and Shrub Wetlands and Salt Marshes habitat profiles.

Element 5: References

5.1 Literature

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SPECIES PROFILE

Black Guillemot

Cepphus grylle

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3
Author: Alina J. Pyzikiewicz, NHFG

Element 1: Distribution and Habitat

1.1 Habitat Description

Black guillemots inhabit rocky coasts and rocky offshore coastal islands (Borror 1994, Butler and Buckley 2002). Eggs are placed directly on rocks, and so to protect against predation, nesting colonies occur along rocky coasts under storm tossed rocks or in rocky crevices (Borror 1994). Cairns (1980) observed black guillemots nesting under tree roots and earth-lined holes. Preferred foraging areas are shallow inshore waters with bottom-dwelling crustaceans, fish, and invertebrates (Borror 1994, Butler and Buckley 2002). Wintering areas are generally the same as breeding areas, except at sites with solid ice cover where black guillemots move offshore to open waters with pack ice (Butler and Buckley 2002).

1.2 Justification

The black guillemot is of conservation concern because New Hampshire is the southernmost extent of its breeding range (Borror 1994) and it is a high priority species in Breeding Conservation Range 14 (Dettmers, unpublished data). Fewer than 5 breeding pairs of black guillemots occur on New Hampshire's coastal islands (Hunt, unpublished data). Increased concentrations of predatory great black backed gulls (*Larus marinus*) pose a threat to black guillemot chicks, further jeopardizing already small populations (Butler and Buckley 2002). Black guillemots are at great risk for biomagnification of heavy metals because they forage in shallow waters of the sea floor where sediment contaminants are highest (Butler and Buckley 2002). Global warming may also affect populations of black guillemots by forcing them to move further south where breeding and foraging habitats may be unsuitable.

1.3 Protection and Regulatory Status

The black guillemot is a species of special concern in New Hampshire. It is protected under the Migratory Bird Act and various non-government coastal water bird programs (e.g., Bird Conservation Regional Plans, Waterbird Conservation for the Americas, Gulf of Maine Council on the Marine Environment).

1.4 Population and Habitat Distribution

The range of black guillemots extends from remote islands in the Canadian Arctic down to offshore islands in southern New England with some birds occasionally wintering as far south as New Jersey (Borror 1994, Butler and Buckley 2002). Population estimates for North America are between 100,000 and 200,000 birds with 25,000 birds in Biological Conservation Region 14 (Kushlan et al. 2002). In New Hampshire, black guillemots have only been found off the coast on the Isles of Shoals, with occasional winter sightings along the mainland coast (New Hampshire Bird Records, Borror 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Sources of information include Birds of North America, New Hampshire Bird Records, the North American Waterbird Conservation Plan, and peer-reviewed scientific literature.

1.8 Extent and Quality of Data

The habitat and distribution of black guillemots in North America are well studied, but little is known about their distribution in New Hampshire due to a lack of adequate census data.

1.9 Distribution Research

Develop accurate census techniques to track population trends in black guillemots. Conduct breeding surveys to estimate population size and effects of global warming. Identify and monitor important nesting, foraging, and wintering areas.

Element 5: References

5.1 Literature

Borror, A. C. 1994. Black guillemot. Pages 100 –101 i*n* C. R Foss, editor. Breeding bird atlas of New Hampshire. Arcadia, Dover, New Hampshire, USA.

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5.2 Data Sources

New Hampshire Bird Records. New Hampshire Audubon, Concord, New Hampshire, USA.

SPECIES PROFILE

Cerulean Warbler

Dendroica cerulea

Federal Listing: Not listed
State Listing: Special Concern
Global Rank: G4
State Rank: S3B
Author: Pamela D. Hunt, NHA

Element 1: Distribution and Habitat

1.1 Habitat Description

During the breeding season, cerulean warblers occupy 2 different types of hardwood forest: floodplain and upland. The species occurs along major rivers, or occasionally on lakes, in closed canopy and among scattered tall trees (Hamel 2000a, b). In parts of Appalachia, cerulean warblers also use mesic forests on mountain slopes. In these uplands, the highest warbler densities occur in oak-hickory and beech-maple stands (Hamel 2000a, Rosenberg et al. 2000).

Within both habitat types, birds prefer areas with taller trees, though empirical data are few (Hamel 2000a). Increasing evidence suggests that canopy gaps are also important (Oliarnyk and Robertson 1996, Hamel 2000a), although the extent to which such an association reflects a preference for old-growth forest conditions is unclear. Gaps in many of the forest types used by the species may be created by flooding or other natural disturbances unrelated to forest age (Jones and Robertson 2001). Gaps may also be mimicked by protruding canopy on forested slopes or by periodic forest management (Hamel 2000a).

Data are equivocal on the effects of disturbance on populations. There is some indication that the species is area sensitive, with minimum areas of 700 and 1,600 hectares (1,750 and 4,000 acres) in the Mid-Atlantic and lower Mississippi regions, respectively (Hamel 2000a). Some stable populations require areas as large as 8,000 ha (20,000 acres). Again, high variability across the species' range makes generalizing habitat needs difficult, and area sensitivity may be tied to broader patterns of landscape use and forest type.

Ceruleans in New Hampshire appear to use both upland and floodplain hardwood forests. The primary population at Pawtuckaway State Park occupies a mixed red oak/red maple/white pine forest (New Hampshire Division of Parks and Lands, unpublished data) that occurs at relatively high elevation (400 to 900 ft) on variable slopes. This is most similar to the habitat used in the northern Appalachians (Rosenberg et al. 2000). Mount Wantastiquet in Hinsdale/Chesterfield is another steep, upland hardwood site (35% grade) with records of ceruleans. The red maple dominated floodplain of the Blackwater River in Salisbury also has multiple records and is typical of floodplain in the area. Here, less prominent trees include American elm, white ash, silver maple, and birches (Foss et al. 2000, unpublished data). Floodplain at the mouth of the Ashuelot River in Hinsdale may also host cerulean warblers.

1.2 Justification

The cerulean warbler has declined dramatically in the last 40 years (Robbins et al. 1992, Sauer et al. 2004), although increases have been noted in parts of the Northeast since the late 1980s. The small New Hampshire population, first detected in 1992, may be associated with this regional increase. Because of its overall rarity in New England, the species is included in the Comprehensive Wildlife Conservation Strategies in all 6 states. Because of its decline, it is similarly listed throughout its range.

1.3 Protection and Regulatory Status

This species is federally protected by the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and the collecting of their nests or eggs. The cerulean warbler is not protected under the federal Endangered Species Act, although it has been nominated for listing as "threatened".

1.4 Population and Habitat Distribution

With the exception of records from 1918 and 1929, all records of cerulean warbler in New Hampshire come after 1970. If isolated May records represent errant migrators, there remain 8 areas with records suggestive of at least the potential for breeding activity because they were later in the spring (table 1).

Of these areas, only Pawtuckaway has a consistent history of use by ceruleans, although the Wantastiquet and Blackwater sites would benefit from more regular and intensive surveying. Numbers of territorial males at Pawtuckaway have ranged from one to 4 (possibly 5) since the species was first detected there in 1992. The maximum count came during intensive surveys in 2002 (Hunt 2003), and may thus better reflect the actual population at the site. Breeding was first confirmed in 1995, when a female was observed carrying nesting material. The following year a nest was found during construction and was observed through the fledging of 2 to 3 young in June.

Pawtuckaway marks the northeastern-most known locality for ceruleans in North America, and New Hampshire appears to have been colonized fairly recently. Small isolated populations also occur along Lake Champlain in Vermont (Laughlin and Kibbe 1985) and around the Quabbin Reservoir in Massachusetts (Veit and Petersen 1993). The species is more common to the south and west and at several sites in Connecticut (Zeransky and Baptist 1990), New York (Andrle and Carroll 1988), and southeastern Ontario (Jones and Robertson 2001).

This recent colonization is consistent with a gradual shifting of the range to the north and east since 1966 (Hamel et al. 2004). According to BBS data, populations at the northeastern edge of the range have been increasing since the late 1980s (Sauer et al. 2004). However, over the range as a whole, including high-density regions such as the Appalachians, Midwest, and central Mississippi Valley, the species has declined at an annual rate of 4.2% since 1966 (Sauer et al. 2004). Even at the northern periphery, where range expansion is occurring, productivity may not be high enough to compensate for mortality (Jones et al. 2004).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in section 5. Cerulean warbler data for New Hampshire came from New Hampshire Bird Records.

1.8 Extent and Quality of Data

Of the locations listed above for cerulean warblers, only Pawtuckaway is regularly surveyed. Thus, although data indicate the presence of ceruleans at other locations such as Hinsdale and Salisbury, they to not guarantee frequent habitation. Even at Pawtuckaway, there has been only one effort to assess the overall population size (Hunt 2003).

1.9 Distribution Research

Although the cerulean warbler is rare in the state, more data on its actual distribution would be valuable for conservation concerns. Searches of known or potential cerulean habitat could document the species' presence in parts of the state other than Pawtuckaway State Park and thus provide a better idea of its status in the state. Initial efforts should focus on the lower Connecticut Valley and the Blackwater River, where the bulk of recent sightings (away from Pawtuckaway) have occurred.

Element 2: Species/Habitat Condition

2.1 Scale

Cerulean warblers occur primarily in the lower Connecticut River Valley, on the Blackwater River, and in the Pawtuckaway Highlands. Habitat delineations should extend beyond immediate sighting locations to include adjacent areas of suitable habitat, as near Pawtuckaway where the Canadia site may be hospitable.

2.2 Relative Health of Populations

Data are insufficient to address population health for all areas except Pawtuckaway. At this site, the population appears to have remained relatively constant (1 to 4 males) for over a decade.

2.3 Population Management Status

There is currently no management of cerulean warblers in New Hampshire.

2.4 Relative Quality of Habitat Patches

All 3 units appear to provide quality habitat for cerulean warblers. All are relatively large blocks of forest, and with the exception of the Ashuelot River mouth, are protected to some degree (see section 2.5).

2.5 Habitat Patch Protection Status

All 3 locations with multiple records of cerulean warblers are protected by fee-simple ownership. Mount Wantastiquet and the Pawtuckaway highlands are both owned by NHDRED, and neither is subject to extensive recreational development. The Blackwater River site is owned by the USACE as part of a flood control project. The other high potential sites in table 1 (particularly the Ashuelot River mouth and Granite Lake) are not protected.

2.6 Habitat Management Status

There is no specific management of cerulean warbler habitat in New Hampshire.

2.7 Sources of Information

Information on areas used by cerulean warblers in New Hampshire was obtained from New Hampshire Bird Records.

2.8 Extent and Quality of Data

With the exception of the Pawtuckaway highlands, data on cerulean warbler use of most units identified in section 2.1 are minimal. The absence of records from either should not be taken as an indication that the species has not been present in a given breeding season.

2.9 Condition Assessment Research

In the absence of good distribution data, it is difficult to identify potential research questions pertaining to habitat condition. Given the small size of the known population, it is not clear whether meaningful indicators could be developed to assess population health. The best option may simply be to devise a regular monitoring program to detect changes in population size and site occupancy.

Element 3: Species and Habitat Threat Assessment

3.1 Identification of threats

Over much of the breeding range, habitat loss is a major cause of population decline (Hamel 2000a, b; Rosenberg et al. 2000). Similar conversion of primary forest in the South American wintering range is also implicated in the decline, although data on winter habitat use are incomplete (Robbins et al. 1992, Hamel 2000b). In the Northeast, where populations appear to be increasing, perhaps because of ongoing reforestation (Jones and Robertson 2001), the major threats are likely to be fragmentation and isolation of currently occupied areas. In all areas of the range, land-use may have increased brood parasitism by brown-headed cowbirds (*Molothrus ater*), a species which is more common along marginal areas (Hamel 2000a).

Given that most threats are related to habitat loss, the small cerulean warbler population in New Hampshire does not appear to be under any immediate threats at the state level. The primary population occurs in an undeveloped area of a state park, and other sites with recent sightings during the breeding season are conserved (section 2.5). Cowbird parasitism may be an important factor, but data on its magnitude and effects within the state are completely unknown.

3.2 Sources of Information

Information on threats to cerulean warblers was obtained from the scientific literature on the species.

3.3 Extent and Quality of Data

Data on regionally identified threats to this species at the scale of New Hampshire are insufficient.

3.4 Threat Assessment Research

It would be worthwhile to determine the rates of habitat loss in the vicinity of the 3 units listed in section 2.1. Although the areas where ceruleans have been recorded are protected, the possibility of area sensitivity in this species should be taken into consideration. In the event that a given unit is under greater threat from landscape-scale habitat conversion, land protection activity in that unit should be considered (element 4).

Element 4: Conservation Actions

No threats to this species are independent of threats to its preferred habitats, and thus no additional conservation actions need detailed discussion. However, the possibility of land protection in the vicinity of core areas should be considered when prioritizing reserve creation. Focusing land conservation on the 3 cerulean warbler units potentially would benefit the warbler, and would enhance habitat quality for associated species and natural communities.

4.2 Conservation Action Research

There are insufficient data to determine whether active management can benefit cerulean warblers (Hamel 2000a), though undue manipulation might harm them. Given what is known about cerulean warbler habitat preferences elsewhere, it may be worth investigating the species' habitat use in New Hampshire in more detail. Any data collected could be compared with those collected elsewhere in an effort to determine whether any specific management practice (e.g., timber harvest rotations, selective cutting, etc.) would affect the species. With sufficient information, it may be possible to manage existing sites for the cerulean warblers, but this should not be undertaken until more about its habitat needs is known.

Element 5: References

5.1 Literature

Andrle, R.F., and J.R. Carroll. 1988. The Atlas of Breeding Birds in New York State. Cornell University Press, Ithaca.

Foss, C.R., P.D. Hunt, and D.B. Wells. 2000. Floodplain Bird report. Report to New Hampshire Department of Environmental Services, New Hampshire Audubon, Concord.

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Robbins, C.S., J.W. Fitzpatrick, and P.B. Hamel. 1992. A warbler in trouble: *Dendroica cerulea*. Pages 549-562 *in* Ecology and Conservation of Neotropical Migrant Landbirds, J.M. Hagan and D.W. Johnston, editors. Smithsonian Institution Press.

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5.2 Data Sources

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord.

SPECIES PROFILE

Common Loon

Gavia immer

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S3
Authors: Harry Vogel and Kate Taylor, Loon Preservation Committee

Element 1: Distribution and Habitat

1.1 Habitat Description

Breeding and Nesting Habitat: Loons nest on lakes greater than 6.5 ha (16 ac) but prefer lakes smaller than 24 ha (60 ac) with clear water, small islands, and an irregular shoreline that creates coves. They are also found on major rivers. Lake size and configuration are important determinates for loon density.

Loons nest in close proximity to the water's edge and prefer the lee side of small islands, floating bog mats, and hummocks in marshes (Christenson 1981, Titus and VanDruff 1981, Yonge 1981, Dahmer 1986). Islands can provide the widest range of visibility for loons on the territory and afford better protection from mammalian predators. Marsh and mainland sites are less preferred and are most likely used in response to shoreline development (Alvo 1981, Christenson 1981, McIntyre 1988) and high conspecific densities.

Nest sites generally are within 1 m from the shoreline (Sutcliffe 1980). Available submerged and emergent vegetation is used for nest structures. Extent of the nest bowl diameter varies (27 to 38 cm), and use of depressions, or "scrape" bowls is common (Sutcliffe 1980, Loon Preservation Committee (LPC), unpublished data). Mainland nest sites are more likely to be structures as opposed to scrapes or hummocks (Sutcliffe 1980). Some loons use sites with steep drop-offs that allow for underwater approaches and exits (Olson and Marshall 1952, Christenson 1981, McIntyre 1988), though this is not a predictor of site location (Sutcliffe 1980, Valley 1987). Strong (1987) found between-year reuse of nest sites by Common Loons to be 78-88%. Changes in nest locations were more frequent after nest failures and reuse in subsequent years occurred more often after successful nests (McIntyre 1988).

Chick Rearing Habitat: Chick rearing areas are typically in shallow water close to shore, having prey size classes suitable for feeding young, and experience less prevailing wind and waves that can separate chicks from adults. Chicks have been observed to hide among shoreline vegetation in response to threats or when left unattended (Yonge 1981, Strong and Bissonette 1987).

Winter Habitat: Near-shore coastal waters including bays, channels and inlets serve as winter habitat. Wintering loons generally use more placid waters less than 20 m in depth within 100 km from shore (Haney 1990, Jodice 1992).

1.2 Justification

Lakes and associated shorelines are under great anthropogenic pressure. The response of wildlife and aquatic ecosystems to such pressures needs to be quantitatively monitored using appropriate species. Common Loons have declined or are absent from much of their historical breeding range in North America. Between 1978 and 2000, LPC activities promoted increases in numbers of territorial loon pairs, nesting pairs, successful nests, and fledged young. However, monitoring also revealed a significant decline ($P < 0.05$) in loon reproductive success from 1982 on. Negative trends in loon breeding success have resulted in 5 successive years of declines in the adult loon population in New Hampshire.

The limited dispersal, low population densities, and low reproductive potential of loons limit LPC's ability to recover a declining loon population; only intensive management has increased New Hampshire's population since loons were listed as a state-threatened species.

1.3 Protection and Regulatory Status

Common Loons are protected from illegal take under the Migratory Bird Act of 1918 and are listed as a threatened species in New Hampshire under New Hampshire RSA 212-A, the Endangered Species Conservation Act.

1.4 Population and Habitat Distribution

Loons are widely distributed in freshwater lakes and large rivers in New Hampshire north and south of the White Mountains. Populations are sparse in western parts of Sullivan and Cheshire counties, as well as in Hillsborough county and eastern parts of Strafford and Rockingham counties.

Migration occurs on a wide front throughout New Hampshire, and fall migration is more protracted than spring arrival (Evers 2004). Staging primarily occurs on larger lakes, such as Lake Winnipesaukee, Squam Lake, Lake Sunapee, and Newfound Lake (LPC, unpublished data) before migration to the ocean. Loons from New England winter off the Atlantic coast from Maine south along coastal Massachusetts into Long Island Sound (LPC, unpublished data, BioDiversity Research Institute, (BRI) unpublished data).

1.5 Town Distribution Map

See Figure 1: Distribution of Common Loons In New Hampshire

1.6 Habitat Map

N/A

1.7 Sources of Information

Information on Common Loon habitat, population distribution, and status is from LPC's database and technical field reports, the Status and Assessment Plan for Common Loons in North America (Evers 2004), and peer-reviewed journals.

1.8 Extent and Quality of Data

The Common Loon is one of the most intensively monitored and managed species in New Hampshire. Statewide surveys have been conducted annually by LPC since 1976.

1.9 Distribution Research

The distribution of loons in New Hampshire is well known (see section 1.4). Identification of potential habitat is currently in progress through habitat modeling efforts. Little is known about wintering populations of loons. Cape May Bird Observatory in New Jersey monitors loons during migration in the Northeast. Christmas Bird Counts provide limited wintering loon information, but volunteer observations are not primarily focused on loons. Annual wintering data will enhance current state loon population monitoring and trend analyses and will serve to flag injury from oil spills, contaminants, and other disturbances on the wintering grounds that have the potential of harming breeding success.

Element 2: Species/Habitat Condition

2.1 Scale

Modeling of suitable habitat, in combination with known dispersal distances of loons, suggest distinct populations north and south of the White Mountains (J. Grear, USEPA, personal communication). This assessment is born out by genetic markers in loon blood (McMillian 2004). Levels of management and challenges facing loons also differ north and south of the White Mountains (LPC, unpublished data).

2.2 Relative Health of Populations

Northern and southern loon populations have increased significantly ($P < 0.05$) since 1977; however, the northern population has shown a significant decrease ($P < 0.05$) over the last 10 years. The northern population has lower reproductive success than the southern population, but the reproductive success of both populations has trended upward ($P < 0.05$) over time (LPC, unpublished data).

2.3 Population Management Status

- Rafts were provided to 11% of northern territorial pairs and 8% of southern pairs in 2004.
- Signs and rope lines were placed around 6% of nests in northern New Hampshire and 28% of nests in southern New Hampshire in 2004.
- On Lake Umbagog, water levels are managed for stability during critical nesting periods for 20 territorial loon pairs.
- Taken together, 53% of territorial loon pairs in northern New Hampshire benefited from management efforts as compared to 27% of territorial pairs in southern New Hampshire in 2004.

2.4 Relative Quality of Habitat Patches

Efforts to quantify habitat quality are currently under way. A pilot study in central New Hampshire found a correlation between a loon habitat ranking index and productivity, indicating it as a suitable predictive model of habitat quality for loons.

2.5 Habitat Patch Protection Status

The Comprehensive Shoreland Protection Act RSA 483-B was created in 1994 to protect against activities affecting water quality by setting minimum standards and requirements for the use of land within 250 feet of the water's edge. Loon nests on protected shoreline remain vulnerable to recreational use of public waters.

2.6 Habitat Management Status

See section 2.3

2.7 Sources of Information

Information on habitat patch protection status was obtained from NHDES. Data on rafts, water-level management, and signs were derived from LPC's database.

2.8 Extent and Quality of Data

The Common Loon is one of the most intensively monitored and managed species in New Hampshire. Statewide surveys have been conducted annually by LPC since 1976.

2.9 Condition Assessment Research

Research is needed to determine the minimum number of territorial pairs necessary to sustain a loon population in New Hampshire, and to determine carrying capacity, longevity, and mortality of subadult and adult loons. This information needs to be understood in a spatially explicit way to avoid local extinctions and can be accomplished by identifying habitat availability and the structure of the state's metapopulation and subpopulations.

Element 3: Species and Habitat Threat Assessment

3.1.1. Development (Habitat Loss and Conversion)

(A) Exposure Pathway

The quality of loon breeding habitat is affected by shoreline development through vegetative modification or removal, creation of structures in close proximity to traditional nesting sites, increased predator densities, and human activity. Often sites favored by loons for nesting and chick rearing, such as islands and quiet bays, are of prime development value. Loons, particularly those breeding pairs that are unaccustomed to people, are likely to locate nest and nursery sites distant from human presence (Alvo 1981, LPC, unpublished data). Therefore, shoreline development in high quality loon breeding habitats, such as island habitats, can restrict use of these habitats by a territorial pair. Furthermore, loon presence attracts potential property owners.

Raccoons (*Procyon lotor*) are widely considered the most influential egg-predator of loons. Densities of raccoons and other opportunistic predators, such as gulls and corvids are generally correlated with increasing shoreline development (Evers 2004).

Removal of shoreline vegetation causes erosion and an increase in water temperatures. Ensuing sedimentation and phosphorus enrichment of the lake can contribute to excessive algae and aquatic weed growth, reduced water clarity and quality, and changed prey density and aquatic food webs.

(B) Evidence
Habitat degradation and loss because of shoreline development have been cited as reasons for declines in local breeding populations and in reproductive success (Alvo 1981, Dahmer 1986, McIntyre 1988). Erosion at construction sites is a leading cause of water quality problems in New Hampshire waterbodies (NHDES 2003).

3.1.2 Recreation (Boats and Jet Skis)

(A) Exposure Pathway
Non-motorized watercrafts, such as canoes and kayaks, have access to shallow water near loon nesting and brood sites, which can lead to nest abandonment. Additionally, canoeists and kayakers are more apt to use remote areas and have a greater ability for stealth. This type of activity is most detrimental during early incubation when egg investment is lowest and the likelihood of nest abandonment is highest. Disturbance from sailboats and windsurfing has not been quantified. Anecdotal and behavioral evidence suggests a sail can be perceived as a visual threat, and therefore has the potential to disrupt nesting and brooding activity, even in areas of high recreational use (LPC, unpublished data).

Loons can habituate to moderate use of motorboats. Recreational motor boating represents a greater disturbance and risk to loon adults and young in open water than to those nesting and foraging in shallow water. Habituation to boating activity can dull response times in loons, making them more susceptible to collisions (LPC, unpublished data).

Personal watercraft can cause significant damage since they have a shallow draft and are able to closely approach nests and shorelines at high speeds. Repeated travel of personal watercraft near nest sites or loon families for extended periods of time can disrupt incubation, expose eggs to predators, or impede parental care of young (Burger 1998).

Excessive angler use of shallow, vegetated areas of lakes through wading and boating can disturb nesting and foraging activity (Titus 1978, Titus and VanDruff 1981, Christenson 1981, Kelly 1992). The increased popularity of fishing tournaments offering substantial prizes can create an unfortunate incentive for improper practices. In New Hampshire and Maine, vulnerable nesting pairs are vigorously monitored during bass tournaments, as some participants regularly disregard posted and cordoned-off nest exclosures (LPC, unpublished data.).

(B) Evidence
Washouts of loon nests and blunt trauma mortality to loons from boats have been documented by Maine Audubon Society (unpublished testimony), Jaruzel (1998), Miconi et al. (2000).
Fourteen percent (32/227) of loon mortality in New England from 1989 to 1996 was due to boat trauma (Miconi et al. 2000).

Though loons on lakes with high human use flush at shorter distances and less readily than those on low use lakes (Smith 1981, Titus and VanDruff 1981), any increase in activity near the nest site may serve to attract predators (McIntyre 1977,1988). Kelly (1992) found that time off-nest was significantly less for flushes related to natural causes than those caused by human disturbance. Christenson (1981) found that adults with young moved away when boats were present. The energetic cost of this is unknown; however, movement in response to boating activity increases the likelihood of chicks being separated from adults and decreases time spent feeding young.

3.1.3. Recreation (Lead Shot and Sinkers)

(A) Exposure Pathway
Lead poisoning in loons in New Hampshire is a direct result of ingesting a Pb object, virtually always a Pb sinker or jig (LPC, unpublished data). Lost or discarded Pb sinkers and jigs are ingested with stones to grind food in the gizzard, with fish that have broken free from an angler's line, or by striking at a sinker or jig on the line. Lead mortality peaks in mid-summer, coincident with peak tourism and angling pressure (LPC, unpublished data), and the presence of swivels and hooks in close to half of the Pb-killed loons suggests that direct ingestion as a result of current fishing practices, rather than the reservoir of tackle on lake bottoms, is the major source of mortality.

Once swallowed, stomach acids and the grinding action of the gizzard dissolve Pb sinkers and jigs. Lead is absorbed into the blood and body tissues. Lead affects nerve impulse transmission causing systemic paralysis and neurological dysfunction, evidenced by head shaking, gaping, wing droop, and eye droop. Other symptoms include green feces, listlessness, lethargy, emaciation, increased occurrence in shallow waters, and frequent bouts of beaching with progression of the condition (LPC, unpublished data). There is no effective treatment for lead poisoning in loons; the ingestion of a single lead sinker or jig can be fatal.

(B) Evidence
Lead poisoning from the ingestion of Pb fishing sinkers and jigs is the largest single cause of known adult loon mortality in New Hampshire and has significantly increased over time ($P<0.001$) (LPC, unpublished data, Tufts University Wildlife Clinic, unpublished data).

Thirteen studies have confirmed a direct link between the ingestion of Pb sinkers and Pb-headed jigs and mortality of Common Loons. Lead poisoning has been identified as a significant cause of Common Loon mortality throughout England, Eastern Canada, and the United States.

3.1.4. Mercury

(A) Exposure Pathway
Mercury (Hg) is a result of anthropogenic sources such as municipal and medical waste incinerators and coal-fired power plants (Swain et al. 1992, USEPA 1997, NESCAUM 1998). Mercury is a highly mobile contaminant with the ability to cycle through land, air, and water. One of its organic forms, methylmercury, bioaccumulates in upper trophic level wildlife, including loons and other piscivorous birds (see Meyer et al. 1995, Evers et al. 1998, 2003, 2005).

Mercury deposition models developed by the USEPA (1997) indicate the northeastern United States to be at particular risk to elevated levels of Hg deposition. Nearly fifty percent of this deposition is from sources within the region. One of the highest exposure areas predicted in these models is the southeastern corner of New Hampshire.

Concentrations of Hg in loon eggs and in adult loons, and the accumulation of Hg in individual loons over time, suggest that current levels of Hg emissions are high enough to pose a threat to loons and other wildlife in New Hampshire. Overall, at least 19% of New Hampshire's adult loon population is at risk to physiological, behavioral, or reproductive impact. At risk individuals have been shown to fledge 37% fewer young. The Hg risk for southern New Hampshire loon populations is at least 32%, while in southeastern New Hampshire the risk is at least 89% (D.C. Evers, unpublished report).

(B) Evidence
The Common Loon has been nationally identified by a USEPA-led working group as one of the best indicators of persistent bioaccumulative toxins, including Hg, in lakes (Wolfe et al. 2004, Evers et al. 2005).

3.2 Sources of Information

Literature review and LPC unpublished data.

3.3 Extent and Quality of Data

Development and associated recreational pressures on lakes have been implicated in loon population declines and reduced breeding success (Titus and Van Druff 1981, Jung 1987, Strong and Bissonette 1987, Kelly 1992). However, loons can successfully breed on water bodies despite disturbance (Jung 1991, K. Taylor and H. Vogel, Loon Preservation Committee, unpublished report) and can adopt adaptive strategies in response to human activity (Alvo 1981, Christenson 1981, Titus and Van Druff 1981, Jung 1987).

Effects of Pb toxicity on loon mortality are well documented, as are levels of Hg in loons in New Hampshire and the effects on loon reproduction.

3.4 Threat Assessment Research

- Efforts are currently under way to assess the relative threat of shoreline development and other factors in order to address overall loon habitat quality. Developing a science-based ranking system to facilitate cooperative restoration efforts in prioritizing habitat of the highest quality is needed for long-term management and protection.
- Continued monitoring of mortality to determine effectiveness of current lead (Pb) tackle legislation is necessary. Research on the mechanisms and severity of various boating activities on likelihood of nesting, hatching success, and chick survivorship needs continuation.
- Continued tracking of Pb mortality to determine effectiveness of current Pb tackle legislation is necessary. Research is needed to assess the persistence of Pb sinkers and jigs in the environment.
- Further research is needed to determine other populations of loons at risk of Hg poisoning in New

Hampshire, to connect known biological hotspots for mercury deposition on lakes and loon territories with source origins in New Hampshire, and to increase our knowledge of Hg in aquatic systems.

Element 4: Conservation Actions

4.1.1 Artificial Nesting Islands ("Rafts")
Category: Restoration and Management

(A) Direct Threat
Loss of nesting habitat from shoreline development, increased nest predators, and artificial water level fluctuations.

(B) Justification
Rafts can facilitate successful nesting for loons that have been displaced from traditional nesting sites due to shoreline development. Rafts also protect nesting loons from water level fluctuations that can flood or strand nests, and provide a measure of protection against mammalian predators associated with shoreline development. DeSorbo et al. (unpublished manuscript) found that nest success in raft nesting loons was higher than that for naturally nesting loons on lakes with and without water level changes. The LPC floats approximately 40 rafts each year in New Hampshire and is experimenting with covers to reduce avian predation and reduce the responsiveness of loons to boaters.

(C) Conservation Performance Objective
Maintain a nesting success rate of 1.2 or higher chicks hatched per raft nesting loon pair.

(D) Performance Monitoring
Monitoring of raft loon nesting loon success will be carried out as part of LPC's regular monitoring duties.

(E) Ecological Response Objective
Long-term ecological response will be to maintain stable or increasing loon populations in southern and northern New Hampshire.

(F) Response Monitoring
Monitoring of raft nesting loon success and population levels will be carried out as part of LPC's regular monitoring duties.

(G) Implementation
The LPC possesses the expertise and infrastructure to build, place, and maintain rafts. A significant expansion of LPC's raft program will require additional personnel and funding.

(H) Feasibility
The LPC is well situated to carry out a raft management program; however, rafts are labor-intensive and an imperfect solution to factors limiting loon nesting success. Rafts are deployed and used as nesting platforms in order to mitigate potential human threats to incubating loon pairs until these threats can be addressed by more permanent solutions.

4.1.2 Signs and Rope Lines

Category: Habitat Protection

(A) Direct Threat
Recreation

(B) Justification
Recreational activities likely play a role in loon hatching and fledging. Territorial pairs on highly developed lakes with signs and float lines surpassed the hatching success of territories without such restrictions (K. Taylor and H. Vogel, Loon Preservation Committee, unpublished report). Use of exclosures should be based on site-specific nest failure history and an understanding of typical lake use patterns. Kelly (1991) recommends floating 3 to 6 signs, approximately 137 m from the nest site for optimal buffering capacity. Exclosures should be removed soon after hatch to maximize public acceptance and compliance.

(C) Conservation Performance Objective
Maintain a nesting success rate of at least 1.2 chicks hatched per protected nest site.

(D) Performance Monitoring
Monitoring of nest sites cordoned off during incubation will be carried out as part of LPC's regular monitoring duties.

(E) Ecological Response Objective
Long-term ecological response will be to maintain stable or increasing loon populations in southern and northern New Hampshire.

(F) Response Monitoring
Monitoring loon pairs in northern and southern New Hampshire will be carried out as part of LPC's regular monitoring duties.

(G) Implementation
An effective design for floating signs and a protocol for roping off nest sites is well established. The LPC possesses the expertise and infrastructure to build, place, and maintain signs and ropes. A significant expansion of LPC's ropes and signs program will require additional personnel and funding.

(H) Feasibility
LPC is well situated to carry out an extensive management program that includes the use of signs and rafts at vulnerable nest sites. However, these techniques are labor-intensive and are an imperfect solution to threats to nesting loons. Rafts and signs can mitigate potential human threats to incubating loon pairs until these threats can be addressed by more permanent solutions.

4.1.3. Boating and Lead

Category: Education and Outreach

(A) Direct Threat
Recreation (Lead Shot and Sinkers)

(B) Justification
Trauma from boats and lead poisoning resulting from the ingestion of Pb fishing tackle have been identified as leading causes of Common Loon mortality throughout Eastern Canada and the United States. Also see sections 3.1.2 and 3.1.3

(C) Conservation Performance Objective
Reduce boating collisions and ingestion of Pb objects in New Hampshire. The current state ban needs to be accompanied by outreach programs and should increase the availability of non-Pb alternatives. Education efforts need to promote responsible fishing and boating practices and continue and expand Pb-exchange programs and increase penalties for use of illegal sinker and jigs. These measures might include forfeiture of license and/or disqualification during fishing tournaments if loon sanctuaries and enclosures are disregarded.

(D) Performance Monitoring
Monitoring of presentations and attendance can be carried out as part of LPC's regular monitoring duties. LPC field biologists can track distribution of non-Pb alternatives.

(E) Ecological Response Objective
The long-term ecological response will be to reduce mortality in order to maintain stable or increasing loon populations in southern and northern New Hampshire.

(F) Response Monitoring
Tracking the causes of loon mortality can be carried out as part of LPC's long-term collaborative mortality study with Tufts University Wildlife Clinic, North Grafton, Massachusetts.

(G) Implementation
LPC regular and field staff can educate through formal and informal contacts in the field.

(H) Feasibility
The LPC is situated to carry out some outreach and non-Pb sinker distribution but is limited by staffing constraints.

4.1.4 Mercury and Lead

Category: Regulation and Policy

(A) Direct Threat
Mercury, Recreation (Lead Shot and Sinkers)

(B) Justification
Lead poisoning resulting from the ingestion of Pb fishing tackle has been identified as a leading cause of Common Loon mortality throughout Eastern Canada and the United States. A long-established culture of Pb use among the angling community and the reluctance of manufacturers to reduce Pb production in favor of alternatives have made voluntary efforts ineffective. Mercury bioaccumulates and biomagnifies in upper trophic level wildlife, including loons and other piscivorous birds, and impairs reproduction (see Meyer et al. 1995, Scheuhammer 1987, 1991). Also see section 3.1.4.

(C) Conservation Performance Objective

End the use of Pb objects in lake systems. Current state-by-state patchwork approach to Pb legislation should be changed to a national ban on Pb accompanied by outreach programs and increasing the availability of non-Pb alternatives. Reduce Hg emissions from known sources in New Hampshire.

(D) Performance Monitoring
Monitoring would assess the effectiveness of efforts to reduce mortality from ingesting Pb tackle and blood Hg levels in loons.

(E) Ecological Response Objective
Long term ecological response will maintain a stable or increasing loon population in southern and northern New Hampshire by keeping loon Hg body burdens below known thresholds (i.e., below 3.0 ppm for blood and below 1.3 for eggs).

(F) Response Monitoring
Monitoring of population levels will be carried out as part of LPC's regular monitoring duties.

(G) Implementation
The LPC will create relationships with legislators and create reports to summarize impacts of Pb and Hg on loons.

(H) Feasibility
Legislation and policy will be conducted by LPC, NHA's Policy Department with testimony by experts from NHDES, NHFG, USFWS, and BioDiversity Research Institute, Gorham Maine.

4.2 Conservation Action Research

- The efficacy of avian guards on rafts to ameliorate avian predation in New Hampshire is yet to be established. Additional research on measures to remove nest platforms and create self-supporting loon territories is needed.
- The efficacy of signs and ropelines on lakes experiencing different levels of recreational use is yet to be fully established. Additional research on this management practice is warranted.
- Research is needed to assess the persistence of Pb sinkers and jigs in the environment and the efficacy of educational efforts to reduce Pb use and irresponsible boating.
- New Hampshire will be included in the national mercury monitoring plan currently being developed (see above "C"). Multiple Hg monitoring stations for collecting levels in the air, water, sediment, fish, and birds will be located in New Hampshire through this effort. Such a national program will be designed to link with Hg emission regulations.

Element 5: References

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SPECIES PROFILE

Common Moorhen

Gallinula chloropus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S2
Author: Kim A. Tuttle, NHFG

Element 1: Distribution and Habitat

1.1 Habitat Description

The common moorhen is a member of the secretive rail family (Rallidae). In the northern United States, moorhens require permanently flooded freshwater or brackish shallow ponds or deep marshes. Common moorhens frequent cattail (*Typha* spp.) marshes; they prefer robust, emergent, tall grass-like vegetation interspersed with pools and channels containing leafy plants (Bannor and Kiviat 2002). Moorhens eat leaves and stems of aquatic plants, as well as smaller amounts of grasses, herbs, seeds and berries, and some animals such as snails, insects, and worms (DeGraaf and Yamasaki 2001). Young moorhens will often eat dragonfly and mayfly nymphs (Hebert and Elkins 1994).

Moorhens may use altered, artificial, agricultural, or urban wetland habitats, including small ponds and sewage lagoons, and they commonly forage on lawns, fields, and golf courses near water (Bannor and Kiviat 2002). Nests are usually found in emergent vegetation, occasionally in shrubs such as willow (*Salix* spp.) or alder (*Alnus* spp). Water depth surrounding nests is usually 0.3 to 0.91m (1 to 3 ft deep). Nests are well concealed by overhanging wetland vegetation (DeGraaf and Yamasaki 2001).

1.2 Justification

Regional declines in moorhen populations have been attributed to loss or degradation of emergent wetland habitats. The common moorhen appears to have extended its range northward in the last century (Bannor and Kiviat 2002) but is thought to be less abundant than in the early 1900s due to the filling of wetlands (Degraaf and Yamasaki 2001).

Invasive, non-native plant species threaten cattail-dominated wetlands and increase the number of subsidized predators such as raccoons (*Procyon lotor*). These threats may be highest in southern New Hampshire, where development is most severe. For example, replacement of cattail by purple loosestrife (*Lythrum salicaria*) may have contributed to a decline in moorhens at Montezuma National Wildlife Refuge, New York (Sibley 1988 in Bannor and Kiviat 2002). The introduction of predatory game fish, such as the largemouth bass (*Micropterus salmoides*), to New Hampshire may further limit range expansion of the common moorhen. Bell and Cordes (1977, in Bannor and Kiviat 2002) collected 5 largemouth bass in Louisiana containing moorhen chicks.

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act (1918)
- See Marsh and Shrub Wetlands habitat profile for regulations regarding wetland impacts.

1.4 Population and Habitat Distribution

The North American breeding range extends from southern Maine to Florida, from the west to southern Minnesota and eastern Texas, and from California to southern New Mexico and south along both Mexican coasts. Wintering populations migrate to the southeastern and southwestern United States, with the largest concentrations in Florida (Hebert and Elkins 1994, Bannor and Kiviat 2002).

In New England, the common moorhen is a rare to uncommon local breeder and migrant (DeGraaf and Yamasaki 2001). It is listed as a Species of Special Concern in Massachusetts (Massachusetts Division of Fisheries and Wildlife 2003) and Endangered in Connecticut (Connecticut Department of Environmental Protection 2004). The breeding population of Massachusetts is estimated between 11 and 20 pairs (Massachusetts Division of Fisheries and Wildlife 2005). Common moorhens have always been thought to be rare and local in Vermont (Environmental Protection Agency 2005).

Common moorhens are rare in New Hampshire and are near the northern edge of the breeding range. The first confirmed nesting occurred in July 1960, with 2 adults and at least 6 young observed on a small pond in Portsmouth, which is no longer considered suitable (Hebert and Elkins 1994). There are New Hampshire breeding records for the towns of Concord, Barrington, Rochester, and Nottingham, as well as a 1998 sighting of an immature moorhen at the Exeter Wastewater Treatment plant. Multiple moorhens have been seen in Rye, Exeter and Orford, whereas single observations in the northern towns of Haverhill, Jefferson, Errol, and Dummer need further documentation to confirm breeding. Single observations have also been recorded in marshes in Hampton Falls, Durham, Newington, Marlow, Hebron, and Holderness (New Hampshire Wildlife Sightings Database 2005, Hebert and Elkins 1994).

1.5 Town Distribution Map

1.6 Habitat Map

See habitat map for Marsh and Shrub Wetlands.

1.7 Sources of Information

NatureServe (2005) was used for status and ranking information. New Hampshire Wildlife Sighting (2005), New Hampshire Heritage Bureau databases (2005), and Hebert and Elkins (1994) were the primary sources of locality records. Habitat and life history information was taken from published literature, including Foss (1994).

1.8 Extent and Quality of Data

The distribution of common moorhen breeding locations in New Hampshire appears to be limited to a few suitable cattail marshes or wastewater treatment facilities in the southeast part of the state. Recent distribution data are largely the result of records submitted to the New Hampshire Wildlife Sightings web page from New Hampshire Bird Records collected and reviewed by NHA. Although common moorhen records are few in the state, submitted reports are carefully reviewed before they are accepted, resulting in high-quality records.

1.9 Distribution Research

Systematic surveys are needed to provide more information regarding distribution, condition, and habitat requirements of the species. NHA volunteers should be recruited to identify common moorhen breeding locations. They should begin around the third week of May, and should concentrate particularly on those areas where breeding is suspected but not confirmed (e.g., Pontook Reservoir in Dummer, Reed Marsh in Orford, and Eel Pond in Rye). Common moorhen, and other uncommon, elusive wetland birds such as the Virginia rail (*Rallus limicola*) and Sora (*Porzana Carolina*) should be incorporated into habitat inventories and management and restoration efforts.

Element 3: Species Threat Assessment

Wetland loss and degradation, including shoreline modification and alteration of vegetated edges, are the greatest threats to common moorhen. See threats in Marsh and Shrub Wetland habitat profile.

Element 4: Conservation Actions

Maintaining natural, tall, grass-like emergent vegetation, especially cattail, at the borders of ponds and wetlands. See Marsh and Shrub Wetland habitat type for relevant conservation strategies.

Element 5: References

5.1 Literature

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SPECIES PROFILE

Common Nighthawk

Chordeiles minor

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S2B
Author: Pamela D. Hunt, NHA

Element 1: Distribution and Habitat

1.1 Habitat Description

Common nighthawks nest on the ground in prairies, rock outcrops, beaches and dunes, forest openings, abandoned quarries, pine barrens, and flat gravel roofs (Poulin et al. 1996). In New Hampshire, nighthawks primarily use pine barrens, openings in Appalachian oak-pine forests, rocky ridges, and urban habitats. In urban areas, they nest on flat gravel rooftops and forage on insects attracted to streetlights. Nighthawks prefer buildings 5 to 15 m (16 to 48 ft) high (Grazma 1967) that are surrounded by a parapet and surfaced with small "pea" gravel (6 to15 mm in diameter, Marzilli 1986, 1989, Wedgewood 1992). Roofs surfaced with larger crushed stone (more than 25 mm) are rarely used by nighthawks (Marzilli 1986, Wedgewood 1992).

Records from non-urban areas are much rarer, and include pine barrens in Concord and the Ossipee area and gravel pits in parts of Hillsborough and western Rockingham Counties. In both, the birds forage over forest openings and adjacent urban or agricultural areas, occasionally using rocky ridges interspersed with low shrubby vegetation and forbs.

1.2 Justification

Data from the Breeding Bird Survey (BBS) suggest that nighthawks are declining over much of their range (around 1.7% annually), particularly in the East (around 4.6% annually, Sauer et al. 2004). Declines have been greater since 1980 than in the period 1966 to 1979. NHA data suggest declines in the lower Merrimack valley, northwest Merrimack County, and the Pemigewasset valley by 1994 (figures 1a and b). Although data from the late 1990s are limited, they indicate significant declines across most of the range (figure 1c). By this time, the species had largely disappeared from coastal New Hampshire, the North Country, upper Connecticut River valley, and much of the Merrimack Valley. Nighthawks were absent from Manchester and had declined in Concord (NHBR). The absence of nighthawks from historic urban sites in the lower Merrimack Valley was confirmed in 2001 and 2002, when surveys failed to locate the species in either Manchester or Nashua (table 1, see also Hunt 2003). These same surveys detected the species in only four urban areas: Woodsville, Franklin, Concord, and Keene (figure 1d). Reports to NHBR between 2000 and 2004 indicate that the species occasionally occurs in Manchester and Berlin, but there are no indications of persistent populations.

The status of nighthawks in rural areas is more difficult to evaluate over this same period, since potential habitats are less likely to be visited at night and because birds are likely to be more dispersed. The most consistently occupied rural area during the last 20 years appears to encompass the pine barrens and other open habitats of the Ossipee area, including the towns of Sandwich, Tamworth, Madison, Ossipee, and Freedom. Other towns where nighthawks were documented in natural habitats (including gravel pits) since 1990 include Auburn, Concord, Croydon, New Boston, Orange (Mt. Cardigan), and Warner (Mt. Kearsarge).

1.3 Protection and Regulatory Status

This species is protected under the Migratory Bird Treaty Act, which prevents the killing of most nongame birds and collection of their nests or eggs. In New Hampshire, it is protected by the New Hampshire Endangered Species Conservation Act (RSA 212).

1.4 Population and Habitat Distribution

The distribution of the common nighthawk in New Hampshire prior to European settlement is unknown, but was presumably limited to pine barrens, heaths, bald mountaintops, and small openings created by fire, wind, or indigenous agriculture. Creation and expansion of urban areas in the nineteenth and twentieth centuries probably allowed the species to expand its range considerably (Andrle and Carroll 1988), although by the 1980s it appears to have declined considerably, especially in natural habitats.

During the Breeding Bird Atlas in the early 1980s, nighthawks were believed to occur almost exclusively in urban habitats (Foss 1994). Although distributed statewide, atlas records were concentrated in the lower Connecticut and Merrimack River valleys and parts of Strafford County. Isolated urban sites included Groveton, Berlin/Gorham, and Conway. Known or suspected nesting in natural areas occurred in the Ossipee area and northwestern Merrimack County.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

N/A

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Data on common nighthawk distribution in New Hampshire were compiled from NHBR, a database maintained by NHA.

1.8 Extent and Quality of Data

Because nighthawks are largely nocturnal, there are limited data on their overall distribution and abundance in New Hampshire. When surveys of urban areas were conducted, there were good estimates of local abundance, but such surveys have not been conducted recently. Information on nighthawks in natural habitat is even more sparse, although recent surveys in the Ossipee Pine Barrens may provide data for this part of the state. There are no consistent surveys of potential habitat at mountaintop balds.

1.9 Distribution Research

Given ongoing declines throughout the Northeast, common nighthawks are included in a list of species identified by Partners in Flight as in need of comprehensive monitoring efforts, including in urban areas. Northeast Partners in Flight is currently developing a monitoring template for nightjars, which will include a section on urban nighthawks.

Monitoring of nighthawks in rural areas is problematic because of their sparse distribution. Whip-poor-will surveys in the Ossipee Pine Barrens may also record nighthawks. In the absence of a rural monitoring program, an effort should be made to visit known and potential sites and search for this species. This effort could use volunteers or be part of a larger statewide distributional assessment, such as a breeding bird atlas.

Element 2: Species/Habitat Condition

2.1 Scale

For the purposes of this profile, nighthawk sites are divided into 4 categories:

- **Ossipee Pine Barrens:** Available data suggest that this is the largest remaining natural population in the state. It can be defined as areas of Effingham, Freedom, Ossipee, Madison, and Tamworth where appropriate habitat remains.
- **Mountaintop Balds:** These are represented by historic sites such as Mts. Cardigan and Kearsarge. Undoubtedly other balds are suitable, although data on nighthawk use are lacking.
- **Other natural habitats:** This unit includes pine barrens and similar habitats in the Merrimack River Valley, as well as any other areas where the species may occur away from urban centers
- **Urban rooftops:** Tall buildings have historically supported nighthawks or have the potential to be used by the species.

2.2 Relative Health of Populations

Declines in almost all of the state's larger urban nighthawk populations (table 1) are indirect evidence of poor population health. If declines result from deteriorating local habitat quality, then the appropriate conservation unit may need to be identified as an individual city. If declines are more pervasive, then larger regional populations could be considered in poor health. There are insufficient data with which to evaluate population health in any of the non-urban areas used by nighthawks in New Hampshire.

2.3 Population Management Status

Nighthawks are not managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

Given increased conservation interest in the Ossipee Pine Barrens by TNC and its partners, this area may be of relatively high quality. Although loss of habitat to development is still a factor, there are plans to reintroduce fire to the ecosystem, which would create additional openings that nighthawks could use. The same is true to a lesser extent for the pine barrens around the Concord Airport (Fuller et al. 2003). There are insufficient data on other pine barrens or sand plain forests to evaluate their current suitability for nighthawks. Mountaintop balds may remain suitable habitats, although data are lacking. For urban areas, habitat evaluation would require data on rooftop construction and configuration.

2.5 Habitat Patch Protection Status

Portions of both the Ossipee and Concord pine barrens have been preserved by easement or fee ownership. At least two mountaintops used by this species historically are protected as part of state parks (Mts. Cardigan and Kearsarge).

2.6 Habitat Management Status

At the Ossipee Pine Barrens, The Nature Conservancy is in the process of developing a habitat management plan to implement prescribed burning and other disturbances to maintain the habitat in a more open condition. Intensive restoration and management began in Concord in 2002, and a management plan was finalized in 2003. Management prescriptions, including burning, forestry, and plant propagation, are targeted at restoring native grass, heath, and shrubland components of the pitch pine-scrub oak woodland community. No management is in place at any of the other areas occupied or potentially occupied by nighthawks in New Hampshire.

2.7 Sources of Information

Data on population trends for common nighthawks were obtained from NHBR and summaries of annual nighthawk surveys between 1982 and 1991 and 2001 and 2002. Information on management activity at specific sites was obtained through discussions with pertinent parties or from existing management plans or agreements.

2.8 Extent and Quality of Data

In the absence of comprehensive surveys, it is difficult to evaluate variation in habitat condition for this species in New Hampshire. There are no data on the specific characteristics of rooftops that could be used to determine the availability of nesting habitat in urban areas.

2.9 Condition Assessment Research

To the extent that urban rooftops once supported the majority of New Hampshire's nighthawk population, research into this habitat and how it has changed is sorely needed. Important data to collect could include the number and area of flat graveled roofs, roof height, and presence/absence of parapets or similar surrounding structures. Such data, when collected in a consistent manner across the primary known or potential urban breeding areas in the state, would be invaluable in assessing the potential for such areas to support or attract healthy common nighthawk populations.

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

See Pine Barrens habitat profile

3.1.2 Development (Habitat Conversion)

(A) Exposure Pathway
The decline of common nighthawks in urban areas over much of its range has been attributed to changes in roof surface materials: from small gravel to large gravel (Wedgewood 1992) or a smooth rubberized surface (Poulin et al. 1996). Smooth rubberized roofs may not provide appropriate camouflage or thermal environment for nighthawk eggs or chicks, and they may allow eggs to roll (Marzilli 1989).

(B) Evidence
Gravel patches were placed on rubber roofs in Orono, Maine in 1986 and 1987 in locations where nighthawks were unlikely to nest. In 3 of 14 cases, nighthawks used these patches for nesting (Marzilli 1989), and they preferred patches placed near parapets, avoiding patches in the center of roofs.

3.1.3 Predation and Herbivory

(A) Exposure Pathway
Several authors (e.g., Laughlin and Kibbe 1985, Petersen and Meservey 2003) have speculated that declines in the closely related whip-poor-will (*Caprimulgus vociferus*) are related to a decline in prey populations. In particular, it has been proposed that saturnid and sphingid moth populations over much of the Northeast were severely depressed following widespread spraying for the introduced gypsy moth (*Lymantria dispar*) from roughly 1950 to 1970. Recovery is believed to have been hampered by a parasitoid fly (*Compsilura concinnata*), which was introduced to combat gypsy moths (Schweitzer 2004). An alternate hypothesis is that moth declines are the result of atmospheric pollution (Andrele and Carroll 1988).

(B) Evidence
There are limited data on the nature and extent of moth declines in eastern North America where most gypsy moth control has historically occurred. In addition, available evidence suggests that moths are a relatively unimportant part of nighthawk diets (Poulin et al 1996). Thus, any connection between large moth populations and nighthawk populations is speculative.

3.1.4 Altered Natural Disturbance (Fire Suppression)

See Pine Barrens habitat profile

3.1.5 Non-Point Source Pollution (Chemical Contaminants)

(A) Exposure pathway
Direct contact with some classes of pesticides is known to cause mortality in birds. Given that nighthawks routinely forage over agricultural areas in both the breeding and non-breeding seasons, the potential exists for them to become contaminated either through their prey or through direct contact.

(B) Evidence
Anecdotal data suggest a link between pesticide spraying and local disappearance of nighthawks (Wedgewood 1992, Foss 1994, Poulin et al. 1996). However, the lack of population recovery following such spraying suggests that additional factors have acted to prevent numbers from increasing once pesticide use was discontinued.

Like several other large aerial insectivores (whip-poor-will, purple martin), nighthawks are potentially affected by events on the winter grounds. Pesticide spraying continues in agricultural areas of southern South America, where the bulk of the population appears to winter (Poulin et al. 1996). Pesticide application during the non-breeding season has been directly implicated in mortality of Swainson's Hawks (*Buteo swainsoni*, Goldstein et al. 1996), and has been suggested for purple martin (Brown 1997) and upland sandpiper (Houston and Bowen 2001).

3.2 Sources of Information

Information used in this section was obtained primarily through a literature review.

3.3 Extent and Quality of Data

Few data are available on listed threats, and data on roof construction and use are highly variable (Bingham 1989). Data are similarly lacking on the effects of pesticides and the nature and extent of changes in the species' prey base.

3.4 Threat Assessment Research

Data are largely lacking on the suitability of urban rooftops for the species, and where they are available there is no way to assess any impact on local nighthawk populations. Data on prey populations and pesticide effects are even more rare. Potential research projects related to threats to nighthawk populations thus include, collection of data on rooftop construction and comparison to historic patterns of nighthawk occupancy, study of nighthawk diets in natural habitats to allow assessment of impacts of presumed moth declines, and study of nighthawk exposure to agricultural pesticides in South America.

Element 4: Conservation Actions

4.1.1 Target Gravel Rooftop Nesting Pads under Backyard Habitat Program, Restoration and Management (see also Strategies, Landowner Incentives Program)

(A) Change in rooftop construction

(B) Justification

- Installation of rooftop gravel nesting pads will replicate nesting substrates that have historically been suitable for nighthawks.
- At the University of Maine in Orono, nighthawks successfully colonized gravel nesting pads (Marzilli 1989).
- Given the rapid rate of decline, immediate action is appropriate. Recolonization attempts are expected to begin upon migration through focal areas.
- Modified rooftops can be monitored for nesting success to inform location and construction of nesting pads.

(C) Conservation Performance Objective
The objective is an increase in the proportion of an urban area's total rooftop space that provides suitable substrate for nesting by common nighthawks. The actual magnitude of change cannot be determined until baseline conditions, and possibly historic conditions, have been assessed as discussed in element 3.

(D) Performance Monitoring
Once current conditions are determined, areas where this action is implemented should be reassessed every 2 to 3 years to determine if the amount of suitable habitat is increasing. Such assessment could include some combination of site visits and review of construction or maintenance records for target buildings.

(E) Ecological Response Objective
The desired ecological response is increased local nighthawk populations in focal areas. There are currently no data on the ability of nighthawk populations to respond to habitat management, so it is impossible to specify a time frame in which this objective should be attained. Until better demographic information is available, nesting success in colonized nest pads may serve as an indicator of response.

(F) Response Monitoring
Responses of local nighthawk populations should be monitored in conjunction with ongoing distribution/trend monitoring proposed under section 1.9. Nesting success in rooftop pads should be monitored (see section 1.9) annually.

(G) Implementation
Potential sites can be identified based on the criteria outlined in section 1.1 (building height, surrounding structures, etc.). If such roofs are surfaced with unsuitable rubber or larger gravel, a gravel patch can be placed on the roof. Gravel patches used in Maine were triangular and 3-m^2 in area, and were placed in the corners of roofs with parapets (Marzilli 1989). Patches should be placed to allow shading by parapets of other roof structures. If these are not available, additional shelter should be provided with the gravel pad. Once in place, such patches may require regular maintenance, although data on patch resiliency are currently unavailable. A program to educate building owners about choices in roof construction would be required to supplement this action.

(H) Feasibility: 1.00
Pending approval of funding for New Hampshire's Landowner Incentive Program proposal, this action can be implemented under the existing Backyard Habitat Program. Implementation will require cooperation with multiple parties that are not traditionally involved with wildlife conservation in New Hampshire, including building managers, construction

companies, and downtown associations. The presence of breeding peregrine falcons in Manchester has made nighthawk conservation more feasible by raising the profile of urban wildlife, and as a result Manchester might be a good place to test this action.

Modifying rooftops using gravel pads is certainly more feasible than any attempt to affect overall roof surfacing guidelines on a statewide basis. However, the option of resurfacing an entire roof with suitable substrate should not be ignored if such an opportunity presents itself. If stakeholder support can be obtained, the primary remaining obstacle to implementation would probably be the costs of materials and labor, and the nature of such costs cannot be determined at this time.

4.1.2 Develop an Urban Wildlife Management Plan, Restoration, and Management (see Strategies, Habitat Management)

4.1.3 Stipulate Roofing Materials on Site Specific Permits, Regulation, and Policy (see Strategies, Environmental Review)

4.1.4 Restore Openings in Pitch Pine-Scrub Oak Woodlands, Restoration and Management (see Pitch Pine-Scrub Oak Woodlands Habitat Profile, see also Strategies, Habitat Management)

4.1.5 Identify Critical Habitats and Focal Populations, Conservation Planning (see Strategies, Conservation Planning)

4.1.6 Advise Town Conservation Commissions on Roof Construction Guidelines, Regulation and Policy (see Strategies, Local Regulation and Policy)

4.2 Conservation Action Research

Evidence in favor of the efficacy of this action is adequate to support implementation.

Element 5: References

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5.2 Data Sources

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Element 6: List of Figures

Figure 1. Distribution of common nighthawks in New Hampshire, 1985-2004. Color coding indicates the maximum number of nighthawks observed in a given town during the five-year period: yellow = 1-4, red = 5-9, black = 10 or more. During the 20-year period, systematic nighthawk surveys were conducted in 1985-91 and 2001-02.

SPECIES PROFILE

Common Tern

Sterna hirundo

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S1
Author: Diane L. De Luca, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Common tern nest on rocky islands, barrier islands, and salt marshes that are close to feeding areas and that provide protection from predators. Common terns nest in the open, on bare ground, or on vegetation, and rarely under cover (but often adjacent to vegetation) (Kress and Hall 2002). On average, nest sites have more than 90% visibility from above (Gochfeld and Burger 1987). A preliminary study of nest site parameters for the New Hampshire Seavey Island colony in 1998 showed that 54% of the nests were located at the rock-vegetation interface, 24% were located on rock and 22% were located in the vegetation.

Common terns feed primarily on juvenile marine fish, but will also eat aquatic and terrestrial invertebrates (Hall 1999, De Luca et al. 1998-2002). Foraging success depends on the abundance and depth of the prey, tidal height, wind speed, and sea surface conditions (Hall 1999). Common terns have a broader diet than roseate and arctic terns and seem to adapt to changing feeding conditions more readily (Safina et al. 1990). At Seavey Island, Isles of Shoals, feeding data collected from 1998 to 2002 identified more than 40 food items. With the exception of 2001, when Atlantic herring *(Clupea harengus)* was eaten with the highest frequency, juvenile white hake *(Urophycis tenius)* has constituted the largest part of the common tern diet on Seavey Island, totaling 45% to 55% of all feedings. Some terns have been observed to feed exclusively on insects or amphipods.

Although no formal study of foraging locations has been conducted, the rate and timing of observed feedings highlight the importance of the waters that immediately surround the Isles of Shoals. Foraging has also been consistently observed in the Hampton and Seabrook harbors, Rye Harbor, and at the mouth of the Piscataqua River.

1.2 Justification

The common tern is a species of regional and state concern. In the Northeast, common tern success is necessary for the recolonization of roseate terns. The common tern colony on Seavey Island should be maintained to successfully manage roseate terns. Managing for common terns will also address the needs of other coastal island species including Arctic Tern, common eider, black guillemot, and purple sandpiper.

Efforts to restore the northeastern common tern population began in the 1970s but have been more organized since 1984, when the Gulf of Maine Tern Working Group was formed. Although common tern restoration efforts have been successful in increasing the number of breeding pairs, the number of islands that support tern colonies remains low. After near extirpation in the late 1800s, the Gulf of Maine now supports over 20,000 pairs of common terns at 47 sites (Kress and Hall 2004). However, 84% of this population nests on 8 islands, leaving them vulnerable to predation, oil spills, and catastrophic weather.

The primary limiting factor for common terns is the loss of nesting sites and predation that led to concentrated colonies in a small number of suitable sites (Kress and Hall 2004, Nisbet 2002). Gull populations took over many of the offshore islands that had supported terns, and other habitats were lost to erosion. This resulted in common terns nesting at marginal inshore islands where the habitat quality was low and the risk of predation was high.

Regionally, the species is in jeopardy due to predation and loss of suitable nesting habitat. In the northeastern United States, gulls, great horned owls, black crowned night heron, coyote, mink, and rats eat eggs, chicks, and adults. Reduced prey abundance, competition for nest sites, contaminants, human disturbance, inclement weather, and insufficient funds to protect colonies also contribute (Nisbet 2002). Little is known about factors affecting the population on its wintering grounds (Kress and Hall 2004, Nisbet 2002).

Common tern nesting is required for successful recolonization of roseate terns in the Northeast. The Seavey Island roseate tern colony largely depends on the protection and success of the common tern colony. Greater than 85% of the entire northeastern population of roseate terns currently nests on four islands from Buzzard's Bay to Long Island, New York, making the entire population vulnerable

1.3 Protection and Regulatory Status

- The common tern is protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the taking of bird, nest, and eggs.
- Seavey Island is under the management of New Hampshire Fish and Game (NHFG). Seavey Island is posted as an endangered species breeding site, and the public is restricted from 1 May to 1 September. Seavey Island is actively managed through the breeding season, and biologists are present at the colony from late April to August.

1.4 Population and Habitat Distribution

Historically, common terns bred on several islands at the Isles of Shoals. Anecdotal evidence suggests that common terns nested in high numbers at Duck Island in the mid 1880s (Borror and Holmes 1990). Jackson and Allen (1931) noted that common terns bred on Lunging Island as early as 1922 and the colony grew rapidly to 1,000 pairs by 1928. Jackson (1947) estimated that 1,500 to 2,000 pairs continued to nest there until 1938, and smaller numbers persisted at this site until the late 1940s. This site was abandoned before 1955 (Taber 1955), apparently because of displacement by herring gulls (Drury 1973, Erwin 1979). Herring and great black-backed gulls continue to nest at this location.

F.B. White (1927) discovered a common tern colony on the mainland coast in Seabrook near the bridge over the Hampton Harbor Inlet. This colony, which fluctuated in size during the 9 years White observed it, apparently peaked in 1929 with at least 118 nests (White 1935). The year of its abandonment is unknown, but existing records indicate the presence of a single nest with eggs in 1953.

Several islands in the Great Bay estuary, including Nannie, Hen, Goat, and the two Footman Islands, have supported nesting terns in recent decades. These colonies apparently peaked around 1970 with approximately 12 pairs on the Footman Islands and 30-40 pairs on Nannie Island (Art Borror, personal communication). Hen Island has supported 1 to 20 pairs of common terns from 1989 to 2004. The Footman Islands have sporadically supported small numbers of nesting pairs in the last 30 years. Nannie Island has not had any documented breeding in recent years. All of these inshore islands have been subjected to significant predator pressures as well as human disturbance.

Tern nesting activity on the salt marshes of the Hampton Harbor estuary dates back to at least 1964. Approximately 50 pairs nested in the salt marsh in the 1970s and 1980s. These numbers have continued to decline and fewer than 25 pairs remain. Heavy predation and flooding have caused very low productivity in most years. This population is unlikely to survive under current conditions.

Although the year of origin for the Back Channel colony is unknown, New Castle residents recall tern activity dating back at least 50 years. Past nesting has occurred on Pest and Leach's Islands as well as on 3 small islands known as the Back Channel Islands. Numbers fluctuated from 15 to 20 pairs in the early 1960s to only 1 pair in 1971, and back up to 44 pairs in 1982 (Foss 1982). This colony continued to decline through the 1980s and early 1990s due to predation and disturbance. This site was abandoned in 1998 after the Seavey Island colony was established.

In 1997, NHFG and the New Hampshire Audubon (NHA) began a project to restore terns to the Isles of Shoals. They worked with the New Hampshire Coastal Program, the Department of Resources and Economic Development – Parks Division, Wildlife Services of the USDA, Shoals Marine Laboratory, Isles of Shoals Steamship Company, the Gulf of Maine Seabird Working Group and the United States Fish and Wildlife Service (USFWS) to complete the first year of this project using nonlethal means of gull control, along with decoys and sound to attract breeding terns back to the Isles of Shoals. In 1997, a small colony of six pairs raised and fledged six young at this site. This colony has continued to show significant growth, with breeding pairs climbing from 6 pairs in 1997 to 2582 pairs in 2004 (figure 3).

Regionally, the distribution of the common tern is unchanged since the first records in 1870 (Nisbet 2002), although the numbers have fluctuated widely. Common terns nest from North Carolina to Newfoundland and west through the Great Lakes into northwestern Canada (Kress and Hall 2004). Currently, the estimated number of nesting pairs in this entire region is 82,000 (Nisbet 2002).

In New Hampshire, 99% of common terns currently nest on Seavey Island, Isles of Shoals. Seavey Island is part of a cluster of islands known as the Isles of Shoals (see Coastal Islands profile). The Shoals are located approximately 9 km from Rye Beach and 13 km from the mouth of the Piscataqua River (figure 1). Seavey Island is approximately 1.5 hectares in size, with rugged granite outcroppings pocketed with herbaceous vegetation. Seavey Island is connected to White Island by a cobble tombolo at low tide. The predominant plant species found in the Seavey Island nesting areas include grasses, yarrow (*Achillea millefolium*), seaside goldenrod (*Solidago sempervirens*), black mustard (*Brassica nigra*) and dodder (*Cuscuta gronovii*) (De Luca et al. 1998).

Other nesting sites in New Hampshire include the rocky islands at the Isles of Shoals, small inshore islands in Great and Little Bays and along the Piscataqua River, and the extensive thatched areas in the Hampton-Seabrook salt marshes. In the salt marsh, they build shallow nests atop the mats of dead thatch. On Seavey Island and the tern islands in Great Bay they create shallow grass and stick cups atop the rock and/or vegetation.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

The New Hampshire GRANIT System was used to identify coastal islands. Very small islands were grouped with the nearest adjacent neighboring islands. In total, 96 polygons were grouped into 48 islands, which in turn were clustered into 15 conservation units.

Each conservation unit was defined by parameters such as size, shoreline, development, distance from known and potential contaminant sources, and the distances to the nearest aquaculture operations, oil spill response staging areas, recreational fishing areas, marinas and public beaches. New Hampshire Department of Environmental Services provided the locations of known contamination sources, heliports, oil spill response staging areas, recreational fishing, marinas and aquaculture locations, and airport locations were provided by the New Hampshire Department of Transportation.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG Seavey Island data, New Hampshire Bird Records data, Gulf of Maine Seabird Working Group (GOMSWG) and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

1.8 Extent and Quality of Data

Common terns have been followed closely since the formation of the Gulf of Maine Tern Working Group in 1984. Regionally, common tern breeding colonies have been managed and intensively monitored for more than 20 years. The Seavey Island common tern population has been intensively studied since recolonization in 1997. In New Hampshire, all current and recently occupied tern-nesting sites are surveyed annually during June. Historical habitat at the Isles of Shoals was surveyed in 1977, 1985 and 1995, and an all-island census at the Isles of Shoals is scheduled for June 2005.

Habitat parameters were identified at common tern nests on Seavey Island in 1998. This pilot study produced baseline data for the development of habitat and vegetation profiles of common tern nest sites. The update and continuation of this study, along with the generation of vegetation profiles, will help in the development of a habitat management plan.

Common tern foraging habitat is largely unknown in New Hampshire, though sightings between 1998 and 2001 suggest that common terns forage close to Seavey Island. It will be important to identify critical foraging areas for this species and to explore staging areas in nearby waters.

Little is known about common tern migration and wintering habitat. Large winter concentrations have been identified in Suriname, Trinidad, Brazil, and Argentina (Hays et al. 1997, 1999). It is important to identify and assess common tern wintering habitat.

1.9 Distribution Research

- Continue intensive monitoring of common terns on Seavey Island
- Characterize common tern breeding habitat on Seavey Island
- Evaluate other islands at the Isles of Shoals for suitable tern habitat. Lunging and Duck Islands both supported common and roseate terns historically
- Identify priority habitats and potential sites for restoration
- Conduct surveys and analyze existing data to determine significant foraging and staging areas
- Band tern chicks on Seavey Island to determine recruitment levels and inter-colony movement
- Develop protocol for re-sighting banded birds and coordinating with other islands for data exchange
- Understand movement patterns of common terns within the Gulf of Maine using the marked known aged population
- Evaluate annual interchange of birds between Gulf of Maine and "warm water" groups
- Continue to research migration routes, winter habitat, and winter distribution

Element 2: Species/Habitat Condition

2.1 Scale

Fifteen conservation units have been identified for coastal islands. All 9 islands at the Isles of Shoals are recognized as separate units.

2.2 Relative Health of Populations:

Productivity on Seavey Island has dropped from an average of 1.63 chicks per pair between 2000 and 2002 to 0.75 chicks per pair in 2004 (table 2). Smaller clutch sizes in 2003 and 2004 may have resulted from cool weather and rough seas. It will be important to follow productivity trends and address low productivity if it persists.

The Isles of Shoals population is home to all of New Hampshire's roseate and Arctic terns, and to more than 98% of common terns. This concentration at one site in New Hampshire makes this population very vulnerable to any form of disturbance or catastrophic event. The potential for tern recolonization at any of the identified conservation units outside the Isles of Shoals is low. Predation, disturbance, and the attendant issues of marginal habitat significantly threaten inshore colonies of terns.

Common terns have not nested on any other islands at the Isles of Shoals since the late 1940s. Anecdotal evidence from Duck Island makes the possibility of common and roseate breeding high, with numbers of terns described in the "thousands". Both Lunging and Duck Island are potential tern breeding habitat but currently support large herring and great black-backed gull colonies.

In 2004, common tern colonies were confirmed at two remaining "mainland" sites—Hen Island in Newington and the Hampton salt marsh. The only nesting site with confirmed productivity was at Hen Island in Little Bay. This colony has had approximately 12 pairs since the early 1990s. Productivity has varied but averaged about 1 chick per pair for most years. Although a few birds still attempt to nest in the Hampton salt marsh, they fledge few chicks. Encroachment, predation, human disturbance, and flooding all threaten the salt marsh terns.

2.3 Population Management Status

The Seavey Island tern nesting colony intensively managed. Biologists live on the island during the breeding season to control predators, monitor the productivity of the colony, and implement public outreach. Seavey Island is also posted from 1 May to 1 September to minimize disturbance.

Common terns were re-colonized at this site using techniques that included nonlethal gull control and tern attraction techniques. Nonlethal gull control at Seavey Island included the presence of a dog during the latter half of April, pyrotechnics, regular circumnavigation of the island beginning 30 minutes before sunrise and continuing until 30 minutes after sunrise, and the placement of a large rock in any gull nest cups (NHA and NHFG unpublished reports 1997-2003). Tern attraction techniques included the placement of decoys in suitable habitat along with the broadcast of tern colony sounds (Kress 1983). Common terns nested at this site in the first year of restoration efforts (1997).

Resident tern biologists are able to continue active gull control through the breeding season. Specialist predatory gulls can be removed from the island. Gull control data clearly show that changes in the intensity of direct intervention can affect the success of the colony.

Although it is difficult to land on Seavey Island, the summer months allow for increased boat traffic and visitation to the Isles of Shoals. Tern biologists act as stewards and can help regulate any visitation. Educational visits from Shoals Marine Lab, Star Island, and various other conservation organizations foster the conservation of this seabird colony.

Lighthouse renovation is scheduled to begin in 2005. Construction crews will be working on the lighthouse and other island structures during the breeding season. Coordination with tern project biologists, New Hampshire Parks and Recreation oversight staff, and construction personnel will be imperative to avoid any disturbance to the terns.

There has not been any systematic identification or monitoring of critical foraging resources for the common tern. It is important to understand variation in prey use and the effects on breeding success. In addition, little is known of staging area usage before and after breeding season.

2.4 Relative Quality of Habitat Patches

Nest parameters on Seavey Island were recorded in 1998 to develop habitat and vegetation profiles for common tern nest sites on Seavey Island. Ongoing studies will evaluate the capacity of the island to support more nesting pairs and to document habitat changes, leading to more effective habitat and vegetation management.

The quality of foraging habitat and prey availability near Seavey Island is largely unknown. Foraging studies will determine how prey availability and foraging effort affect productivity. The productivity level of the Seavey Island colony in 2004 (0.75 chicks per nest) was below the level considered productive in the Northeast (more than 1.1 chicks per nest) and well below the high of 2.24 in 1998. It will be important to evaluate the drop in productivity.

The 2 other historic nesting sites for common terns at the Isles of Shoals are Duck Island and Lunging Island. These islands have good potential for tern nesting, yet they each support large numbers of nesting gulls. The presence of raccoons and gulls make tern nesting impractical on Smuttynose Island, though the island once hosted one of the largest gull populations at the Isles of Shoals. Appledore Island is unsuitable for terns because of large populations of gulls, rats, muskrats, raccoon, and humans.

The Hen Island tern colony in Great Bay, which has averaged 12 pairs since 1989, has been disrupted by rats, Canada geese, great horned owl, and humans. A small but persistent tern colony remains in the Hampton salt marsh, though it has been plagued by flooding, predation and human disturbance. Efforts to protect this habitat may improve the potential for nesting.

2.5 Habitat Patch Protection Status

- White and Seavey Islands have been managed by the Department of Resources and Economic Development (DRED)-Parks and Recreation Division as part of Odiorne State Park since 1993. A Memorandum of Agreement on tern restoration exists between DRED – Parks Division and NHFG. Seavey Island is managed by NHFG as an endangered species nesting area and is afforded both state and federal protection under endangered species law.
- The Coastal Islands National Wildlife Refuge pur-

chased Duck Island in July 2003. This island will be managed for its wildlife resources, protected as a seabird colony, posted for closure during the breeding season, and evaluated for habitat management and restoration (B. Benedict, USFWS, personal communication).
- There is no protection at privately owned Lunging Island beyond current shoreline and wetland regulations.
- Smuttynose Island is privately owned but was protected in August 2001 by a conservation easement held by the Coastal Islands National Wildlife Refuge. This conservation easement allows the refuge to manage the site for wildlife resources (B. Benedict, USFWS, personal communication).
- The Town of Newington owns Hen Island. Since the early 1990s, the town has worked with NHFG and NHA to close the island during the breeding season. The proximity of the island to the mainland has subjected Hen Island terns to disruption by rats, Canada geese, great horned owl, and humans.

2.6 Habitat Management Status

Seavey Island is managed for terns through the NHFG and NHA Tern Restoration partnership. Restoration efforts between 1997 and 2004 focused eliminate gull nesting and controlling predation, which allowed some re-colonization by common terns. There has been a gradual shift in the Seavey Island vegetation from yarrow and seaside goldenrod to tall dense grasses. Although the height of the grass makes the habitat more suitable for roseate terns, the density can cause problems for movement of adults and chicks. In 2005, approximately 100 feet of boardwalk was laid through the grassy area to give more structure and opening to the nesting habitat, and to allow biologists access to this part of the island.

It will be important to continue the common tern nest site analysis to evaluate habitat suitability, and to have baseline data from which to make management decisions regarding habitat improvement. Other islands identified in section 2.4 as having the potential for tern recolonization need to have baseline habitat assessments. If determined to be suitable for restoration efforts, a habitat restoration plan would need to be developed and implemented.

2.7 Sources of Information

Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG data, GOMSWG and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

2.8 Extent and Quality of Data

Census and productivity numbers have been taken since common terns began nesting in 1997. Chick provisioning data was collected from 1998 to 2001, and baseline habitat data for common tern nesting sites was collected in 1998. More data are needed to determine the habitat parameters of preferred nesting areas.

The habitat on Lunging and Duck Island needs to be evaluated through a nest census and a vegetation/habitat profile at each site. The identification of important foraging and staging areas for roseate terns in New Hampshire is critical.

2.9 Condition Assessment Research

Monitoring

- Continue intensive monitoring of common terns on Seavey Island, using established methods as outlined by the GOMSWG and the Roseate Tern Recovery Plan to determine productivity
- Resume monitoring of the mainland colonies to assess condition and the potential for protection

Research and Assessment

- Characterize common and roseate tern breeding habitat on Seavey Island. Determine the habitat parameters in preferred nesting habitat. Evaluate the need for vegetation management to maintain and increase common and roseate habitat on Seavey Island.
- Conduct habitat assessments at the other historic Isles of Shoals islands.
- Identify and characterize preferred foraging habitat and evaluate vulnerability of principal foraging sites to human disturbance
- Assess seasonal prey availability and how it relates

to tern productivity
- Assess potential effects of an oil spill near Seavey Island.

Research and Survey:

- Identify the location and use of staging and roosting areas for common and roseate terns
- Determine if pre-migratory staging areas constitute a vulnerable population bottleneck
- Identify important wintering areas

Element 3: Species Threat Assessment

3.1.1 Predation and Herbivory (Gulls)

(A) Exposure Pathway

Herring gulls and great black-backed gulls are major predators on terns and other small seabirds. The protection of all seabirds, changes in human land use along coastal islands, the fishing industry, and the use of open landfills caused gull populations to exponentially increase in the twentieth century (figure 2). Gulls prey on tern eggs and chicks and displace them from prime nesting habitats (Foss 1994). Gulls were partly to blame for the extirpation of roseate terns from New Hampshire, but initiation of active gull control on Seavey Island has allowed for the recolonization of this species. Gulls continue to nest on all the other islands at the Isles of Shoals, making them unsuitable for terns.

Nearshore tern colonies are vulnerable to predators such as rats, raccoons, skunk, and fox. Increased development and human use of coastal areas has allowed for an abundance of potential tern predators (USFWS 1998, Kress and Hall 2004). Great horned owl and black-crowned night heron will fly many kilometers to feed on tern chicks and adults. Other avian predators seen at Seavey Island include peregrine falcon, harrier, and cattle egret. With 99% of the common terns and 100% of the roseate terns in New Hampshire nesting at Seavey Island this species is vulnerable to predation.

(B) Evidence

More effective control of municipal and fishing wastes is helping to control gull populations. However, the New Hampshire seacoast still has a large open landfill located in Rochester, about 46 kilometers from the Isles of Shoals. This landfill supports large numbers of gulls during the winter. The Isles of Shoals remains an active fishing area, and there is evidence that discarded lobster bait and other fishing wastes subsidize local gull populations (Goodale 2000). Lack of gull control has been shown to sharply increase predation and disturbance of nesting terns (Donehower 2003). Although non-lethal gull control has successfully removed nesting gulls from Seavey Island, gull predation continues at this site and is particularly intense during the fledging period.

Nocturnal predators such as the great horned owl and black-crowned night herons prey on terns and may cause colony desertion (Nisbet 1999). A great horned owl killed significant numbers of roseate adults in the 2 largest roseate colonies in Buzzard's Bay, Massachusetts. Black-crowned night heron predation has been documented on Stratton Island, Maine and on Falkner Island, Connecticut. The Stratton Island colony grew from 1 pair in 1995 to 127 pairs in 2001 after black-crowned night herons were controlled. The Falkner Island population fell from 135 pairs in 1997 to 37 pairs in 2004 after black-crowned night heron appeared.

Since 2000, mink have invaded 5 common and roseate tern colonies, resulting in dramatic loss of common and roseate terns and the abandonment of tern colonies from Ship Island, Stratton Island, and Jenny Island. Mink killed every roseate chick on Brothers Island (Canada) in 2 consecutive years. Laughing gulls increased by 75% (close to 4,500 pairs) in the Gulf of Maine in the last 5 years. Laughing gulls may compete with terns for nesting habitat or food and some individuals will eat eggs and chicks. Boats have brought predators (rats and raccoons) to Star, Smuttynose, and Appledore Islands in the Isles of Shoal, causing widespread nesting failure.

3.1.2 Development (Habitat Loss and Conversion)

A) Exposure Pathway

Nearly one-third of the population in the United States (over 75 million people) and Canada (over 9 million people) live within a day's drive of the Gulf of Maine. Vast areas of coastal and offshore marine habitat have been lost or degraded in the last three centuries. The northeastern common tern population is restricted to a small number of islands and many historic nesting islands been lost to erosion or are occupied by gulls. Degradation and disturbance in these areas would all have a negative impact on common tern success. Little is known of critical habitat (foraging, staging, and wintering habitat) of common or roseate terns. Nisbet (2002) cites the need for increased research into winter habitat where it is believed the highest mortality occurs.

(B) Evidence
Critical habitats for common terns and roseate terns should be identified and protected. Seavey Island is important because most of New Hampshire's common terns and all of its roseate terns nest there. Yet scientists do not know basic information such as the location of foraging or staging areas. The 2 known staging areas in the Northeast are in highly developed areas of the coast and may be vulnerable (Casco Bay, Maine and South Beach, Massachusetts).

3.1.3 Unsustainable Harvest (Overfishing)

(A) Exposure Pathway
According to the United Nations Food and Agriculture Organization, more than 70% of the worldwide marine fish stocks are either fully exploited or depleted. In the North Atlantic, the American Fisheries Society has identified 82 species at risk of extinction including Atlantic salmon, Atlantic halibut, and a number of species of sharks, skates, sturgeons, and groupers. Fishing can change the abundance of exploited species and degrade marine habitat (e.g., trawling) (Collie et al. 1997).

Point and non-point source runoff from agricultural and developed coastal areas can negatively impact estuarine and subtidal areas that support food webs in coastal and offshore waters. Climate change will likely warm sea surface temperatures and oceanic circulation, leading to changes in nutrient cycling and marine productivity (Tyrell 2005). Many other activities threaten coastal marine habitat in the Gulf of Maine (for a review, see Tyrell (2005)).

(B) Evidence
Changes in prey availability affect the growth and survival of chicks and the condition of adults (Safina et al. 1988, Nisbet et al. 1995). Prey availability may also impact the size and distribution of colony sites (Nisbet 1999). However, the correlation of reduced prey availability and common and roseate tern productivity has not been firmly established. Other seabirds, including terns, have shown very significant impacts from changes in prey availability. In Britain, breeding failure and diminished adult survival in Arctic terns was linked to changes in fish prey availability due to commercial fisheries activities (Suddaby and Ratcliffe 1997 in Kress and Hall 2004).

In 2004, disappearance of sand eels devastated Scottish seabird colonies; 1,200 guillemot nests on the isle of Shetland failed completely, 24,000 Arctic tern nests were almost entirely empty, and the world's largest colony of great skuas produced only a few chicks. Scientists believe that the sand eels are disappearing because the cold-water plankton that these fish depend on no longer flourishes in these coastal areas. The North Sea has warmed 3.6°F over the last 20 years, shifting the phytoplankton blooms northward or earlier in the season (Schulman 2005). Global warming is widely believed to be responsible for the relatively rapid rise in worldwide ocean temperatures.

3.1.4 Disease (Avian Cholera, Avian Botulism, Salmonella)

(A) Exposure Pathway
Avian cholera is an increasing threat to seabirds (USFWS 1998) and its spread is linked to the poultry industry. It is a highly infectious, lethal disease caused by the bacterium *Pasteurella multocida* (Kress and Hall 2004). The bacterium can persist in carcasses for up to 3 months and in freshwater sources for upwards of 3 weeks. Another bacterial disease, avian botulism, is transmitted through sewage discharge or buildup of organic matter. It infects scavengers (e.g., gulls) and accumulates in dead birds (Kress and Hall 2004). The source and transmission of salmonella in birds is not well understood.

(B) Evidence
In 1988, 37 common terns were found dead on Eastern Egg Rock from avian cholera. This resulted in complete abandonment of the colony with only 37% recolonizing later in the season (Kress 1997). In 1991, large numbers of terns and laughing gulls died from avian botulism on Eastern Egg Rock after a massive menhaden die-off in Muscongus Bay. Avian cholera has killed terns, gulls, and eiders on islands in

Maine. In 2004, close to 2000 common tern chicks were found dead on the nests at Monomoy Island, Massachusetts, with no evidence of external trauma. Test results identified salmonella as the cause of death, but there is no conclusive evidence for the source or transmission of this bacterium.

3.2 Sources of Information

Information on threats to common terns was taken from the literature, the USFWS Tern Management Plan, from the list of threats developed as part of regional bird conservation planning (BCRs 14 and 30), and from Seavey Island management experience. Threats developed for Coastal Islands were also used, with some modification, in the development of the threats and threat rankings for the roseate tern.

3.3 Extent and Quality of Data

Threats to common terns and their breeding habitat are well documented in management and conservation plans. The threat posed by reduced prey availability still needs research and monitoring to determine the correlation with tern productivity. Direct threats to foraging and staging areas are unclear until these areas have been identified.

3.4 Threat Assessment Research

- Assess the effects of tern predators and evaluate means of controlling those species in different critical habitats and at different times of the year
- Determine laughing gull impacts on common and roseate tern nesting success
- Assess and monitor of the effects of aquaculture, fishing practices, and other stressors on terns, tern predators, and habitats
- Identify and protect (if feasible) critical habitats such as foraging, staging, and wintering areas
- Identify seasonal and spatial variation in prey (composition and abundance) and potential effects on colony productivity

Element 4: Conservation Actions

4.1.1 Manage and monitor the Seavey Island colony, Restoration and Management

(A) Direct Threats Affected: Predation, Human disturbance, Oil spill, Avian cholera (disease)

(B) Justification
Tern restoration projects in Maine and Massachusetts in the last 25 years have documented that the productivity and stability of these tern colonies depends on continued management. Currently, all productive tern colonies in the Northeast are being actively managed (USFWS 1998, Kress and Hall 2004). Since 1997, management of the Seavey Island colony has allowed for the successful recolonization of terns to the Isles of Shoals after a more than 50-year absence. Resident biologists act as stewards for the Seavey tern colony and can enforce the closure of this island during the breeding season, as well as providing annual population and productivity estimates. Active management occurs annually during the breeding season from 21 April to 31 August. Active management through the breeding season allows for an immediate response or change in response to all the threats identified above (predation, human disturbance, disease and oil spill).

(C) Conservation Performance Objective
The objective of continued intensive management at Seavey Island is to increase and secure both the common and roseate tern populations. Although there are no established recovery criteria for common terns in the northeast region, a productivity rate in the range of 1.1–1.8 chicks per nest is considered adequate to sustain population growth. The primary objective of the Northeast region roseate tern recovery program is to promote an increase in breeding population size, distribution, and productivity to warrant reclassification to threatened status and eventual delisting. The criteria for recovery include a minimum of 6 large colonies ($\geq$ 200 pairs) with high productivity (<u>at least</u> 1.0 fledged young/nest) for 5 consecutive years. Successful management and monitoring at Seavey Island would maintain productivity of the common tern colony and expand the roseate population to the level cited above and maintain this level for at least 5 years.

(D) Performance Monitoring
The productivity of the Seavey Island common and roseate terns will be monitored annually using established methods outlined in the Roseate Tern Recovery Plan, The Tern Management Handbook and through the regional roseate tern metapopulation study (Nisbet 1990). An all island census will also be conducted annually during the census window of June 12 to 20 as established by the regional tern working group (GOMSWG). Downward trends in either colony census numbers or productivity estimates need to be addressed immediately.

(E) Ecological Response Objective
The desired ecological response to continued monitoring and management is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers on Seavey Island. Successful management will be indicated by a positive growth rate in common terns and the achievement of roseate tern recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring
Annual census numbers and productivity estimates will indicate the health and success of the Seavey Island colony. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation
Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG. Collaboration will occur with state and federal partners working with terns in other northeastern states including Maine, Massachusetts, Connecticut and New York, as well as with international partners in Canada. Important guidance for establishing monitoring protocols will be provided by the New Hampshire Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

(H) Feasibility
Management and monitoring has been occurring at Seavey Island since 1997. The expertise to carry out this project currently exists in New Hampshire. Guidance and collaboration will come from regional tern biologists participating in GOMSWG and members of the RTRT. Securing long term funding will be critical to continued monitoring at this site.

4.1.2 Develop predator management plan, Restoration and Management

(See also: section 3.1.1 and 4.1.1 for predator management on Seavey Island and other island and mainland locations)

(A) Direct Threats Affected: Predation

(B) Justification
Research shows that tern management must continually adapt to changing predator threats. More effective control of municipal and fishing wastes is helping to control gull populations. The New Hampshire seacoast still has a large open landfill located in Rochester, about 46 kilometers from the Isles of Shoals. This landfill supports large numbers of gulls during the winter. The Isles of Shoals remains an active fishing area, and there is evidence that discarded lobster bait and other fishing wastes subsidizes local gull populations (Goodale 2000).

A proactive management plan should exist to better respond to predation from a suite of predators including gulls, great horned owl, black-crowned night heron, and mammalian predators such as mink, raccoons, and rats. Minimizing predator impacts will help achieve long-term growth objectives and reduce the possibility of movement of breeding adults to alternate sites. Incidence of predation and predator concentrations would need to be evaluated periodically (minimum twice per year) to assess management success. If foraging and staging areas are identified, predator management may need to be expanded beyond the breeding season.

(C) Conservation Performance Objective
The objective of continued and more effective management of predator concentrations is to increase and secure common and roseate tern populations, while minimizing mortality and movement.

(D) Performance Monitoring
Methods to evaluate trends in predator populations/

concentrations would need to be established. Obvious sources such as the Rochester landfill could be surveyed on a regular basis to identify changes in predator usage. Fishing regulations, specifically the discarding of fishing wastes, could be assessed in terms of their contribution to predator (gull) populations. Downward trends in either colony census numbers or productivity estimates need to be addressed immediately. See section 3.1.1 for management specific to Seavey Island.

(E) Ecological Response Objective
The desired ecological response to predator management is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers. Successful management will be indicated by a positive growth rate and the achievement of recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring
Annual census numbers and productivity estimates will indicate the health and success of colonies. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation
Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG. Collaboration will occur with state and federal partners working with terns in other northeastern states including Maine, Massachusetts, Connecticut and New York, as well as with international partners in Canada. Important guidance for establishing monitoring protocols will be provided by the New Hampshire Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

(H) Feasibility
The expertise to carry out this project currently exists in New Hampshire. Further guidance will come from regional tern biologists. The cooperation of landowners or managers at sites that are identified as predator concentrations is unknown. Wildlife Services has many years of working in collaboration with some of these land managers so their involvement and expertise is critical. The long term funding of mainland predator management will need to be assessed and potential funding sources identified.

4.1.3 Identify and protect important staging and foraging areas for common and roseate terns, Habitat Protection

(A) Direct Threats Affected: Predation, Habitat Loss, Recreation and Tourism, Contamination

(B) Justification
Little is known of common and roseate tern foraging and staging habitat utilized by Seavey Island birds. The identification and protection of these habitats is critical to the long-term stability of this colony (USFWS 1998, Kress and Hall 2004). The distribution of suitable feeding locations and the availability of prey fish at these locations may influence colony size, distribution, and breeding success (Nisbet and Spendelow 1999). Research shows that common and roseate terns from several sites concentrate and stage at a limited number of locations. This concentration makes large numbers of the entire Gulf of Maine tern population vulnerable during these staging periods. Protection of staging areas should be timely and permanent on a year round basis, with increased protection during identified windows of high use.

(C) Conservation Performance Objective
The objective of identifying and protecting tern foraging and staging areas is to maintain breeding colonies and minimize mortality.

(D) Performance Monitoring
The productivity of the Seavey Island common and roseate terns will be monitored annually using established methods outlined in the Roseate Tern Recovery Plan, The Tern Management Handbook and through the regional roseate tern metapopulation study (Nisbet 1990). An all island census will also be conducted annually during the census window of June 12-20 as established by the regional tern working group (GOMSWG). Downward trends in either colony census numbers or productivity estimates need to be addressed immediately.

(E) Ecological Response
The desired ecological response to protection of foraging and staging areas is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers on Seavey Island. Successful management will be indicated by a positive growth rate and the achievement of recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring
Annual census numbers and productivity estimates will indicate the health and success of the Seavey Island colony. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation
Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG.. Important guidance will be provided by the NH Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

Coordination with land protection specialists from local, state and federal agencies to maximize the potential for successful protection of identified foraging and staging areas. The protection of these habitats may require the innovative protection strategies such as those outlined in the GOMC Marine Protected Areas Project. Federal and state partners from the NHCP, the Coastal Islands Wildlife Refuge, the Great Bay Refuge, and the Great Bay National Estuarine Research Reserve would be important partners. It is likely that areas will be identified across state boundaries and necessitates coordination with Maine and/or Massachusetts partners.

(H) Feasibility
The expertise to carry out this project currently exists in NH with guidance from regional tern biologists. Securing immediate and long term funding will be critical to the identification and protection of foraging and staging areas. Protection of these habitats will take cooperation and coordination of federal, state and local officials.

4.1.4 Develop regional partnerships, Restoration and Management

(B) Justification:
The Tern Restoration Project will benefit from collaboration with other organizations that are focused on resource conservation and management in the Gulf of Maine. NHCP provides the leadership in coordinating local communities, state and federal agencies in the planning and policy issues needed to balance the preservation of New Hampshire's natural resources with the social and economic needs of the coastal region. The Gulf of Maine Council brings together partners from Massachusetts, New Hampshire, Maine, and the Canadian provinces of New Brunswick and Nova Scotia (www.gulfofmaine.org). The Gulf of Maine Habitat Conservation Subcommittee is working with partners in the region to develop and advance marine habitat conservation strategies.

4.1.5 Monitor prey availability during the tern nesting season, Habitat Protection

(A) Direct Threats: Reduced Prey Availability, Contamination

(B) Justification
Further research is needed to assess the role of commercial fisheries on prey availability for seabird colonies. In addition, it is important to support research and policies that help to reduce negative impacts on nursery areas for prey items such as herring, hake and other fish stocks that are important food for seabirds. Some of te partners outlined in section 4.1.1 (G) could coordinate with the NHFG Department Marine Resources Division and the Shoals Marine Laboratory to monitor prey availability. An established monitoring program coupled with the chick provisioning studies taking place on Seavey Island would allow seabird biologists and fisheries managers to collaborate on actions that could benefit seabird restoration.

4.1.6 Education and Outreach

(A) Direct Threats Addressed: All

(B) Justification
The Tern Restoration Project has provided an excel-

lent opportunity for educational outreach. The focus of this outreach has been to foster stewardship, appreciation, and protection for the seabird colony on Seavey Island as well as other Gulf of Maine seabird nesting islands. Opportunities have come through welcoming visitors and other organized classes to the island, sharing the details of the project with charter and ferry boats that visit the Isles of Shoals, and taking the project out to many groups around New Hampshire through a slide presentation and display. It is important that we continue to strengthen and expand outreach efforts on seabird conservation. The development of classroom curriculum and teacher resources will capture an important audience. A tern restoration web page will foster stewardship, increased understanding and appreciation for seabird conservation issues. A web page addition would reach a large, broad audience and expand educational opportunities manifold. These efforts lay the groundwork for increased awareness and understanding of coastal issues that impact seabird islands, and promote stewardship for coastal resources.

(G) Implementation
Improve public outreach and education on seabird restoration issues in New Hampshire and the Gulf of Maine through the following mediums:

- Further develop and implement outreach and education to Isles of Shoals users including the Shoals Marine Lab, Star Island, Seacoast Science Center, and island visitors
- Further develop and implement an outreach program and educational materials for passengers aboard charter vessels in and around the Isles of Shoals including the Uncle Oscar, ISSCO ferry and the Granite State
- Develop a tern restoration presentation and curriculum to be included in the coastal ecology unit presented to middle and high school students aboard the Granite State
- Further develop and implement a teacher workshop that highlights the tern restoration project and seabird conservation issues
- Develop a seabird conservation curriculum that can be used in classroom presentations. Use roseate terns as an example of a successful restoration model
- Create a Tern Restoration/Seabird Conservation Page with live streaming tern video from Seavey Island on the NHA/NHFG Web pages

4.2 Conservation Action Research

- Monitor and manage predator populations on islands and the mainland
- Identify and protect foraging and staging areas
- Assess prey availability and its effect on breeding success and colony dynamics

Element 5: References

5.1 Literature

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Element 6: List of Figures

Year	Nests monitored	Mean clutch size	Mean hatch	Fledglings/nest
1997	6	1	1	1
1998	45	2.56	2.02	1.6
1999	25	2.84	2.48	2.24
2000	43	2.6	2.33	1.58
2001	73	2.44	2.18	1.68
2002	184	2.52	2.09	1.63
2003	163	1.96	1.61	1.33
2004	138	1.84	1.67	0.75

Table 1. Common tern census numbers at Seavey Island 1997-2004.

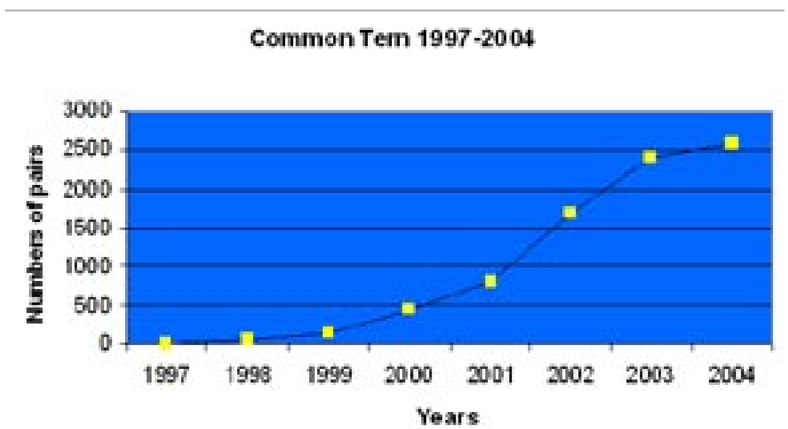

Figure 2. Nesting pairs of herring and great black-backed gulls at the Isles of Shoals 1920-1995 (Numbers compiled from Drury 1973, Borror 1990, USFWS Colonial Waterbird Survey 1995).

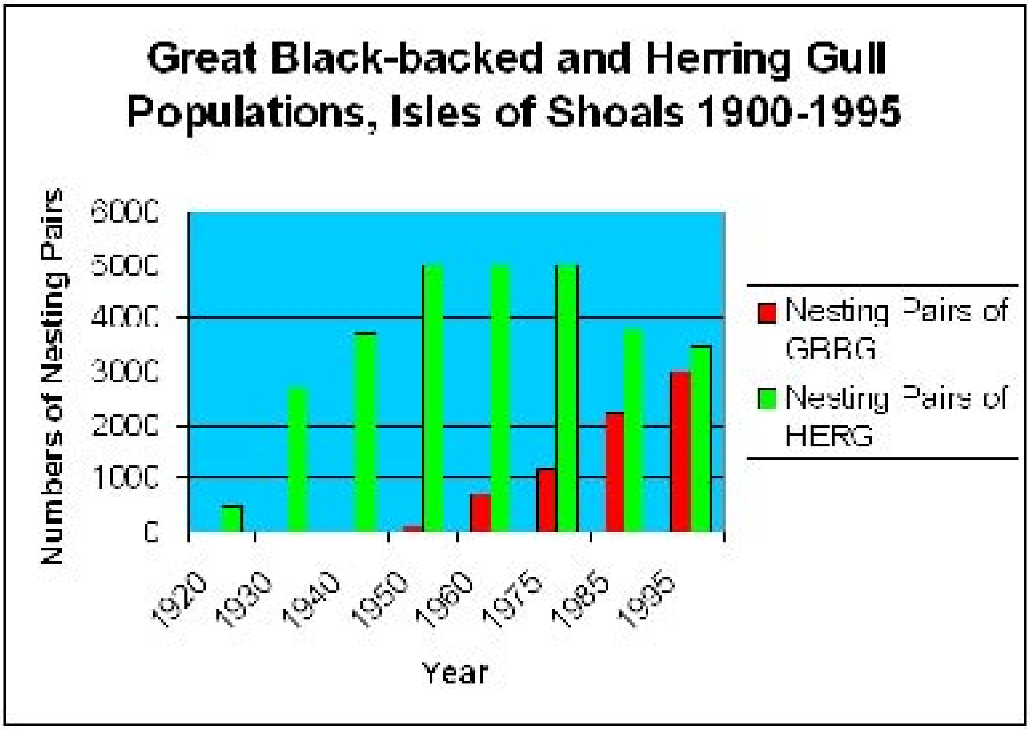

Figure 3. Seavey Island common tern population numbers 1997 - 2004

SPECIES PROFILE

Cooper's Hawk

Accipiter cooperii

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S2B
Authors: M. Yamasaki and C. A. Costello, USDA Forest Service

Element 1: Distribution and Habitat

1.1 Habitat Description

Cooper's hawk breeds in various forest types (e.g., coniferous, deciduous, and mixed woods) ranging from extensive forests to woodlots of 4 to 8 ha (Rosenfield and Bielefeldt 1993). Recently, this raptor has been found nesting successfully in suburban areas and city parks in Pennsylvania, Wisconsin, and New York City (Bielefeldt et al. 1998, McConnell 2003) as well as urban areas in Arizona (Boal and Mannan 1998). Thus, Cooper's hawk may be tolerant of human disturbance and habitat fragmentation. Cooper's hawk nests in crotches, limb axils, and limb forks high off the ground in large hardwood and conifer tree species, often under a dense canopy (Titus and Mosher 1981, Bosakowski et al. 1992a, Rosenfield and Bielefeldt 1993, Trexel et al. 1999, McConnell 2003).

Although little research has been done on Cooper's hawk foraging habitat, breeding-season diet studies indicate that Cooper's hawk preys on small mammals such as squirrels and chipmunks as well as on birds (Bielefeldt et al. 1992, Bosakowski et al. 1992b, Estes and Mannan 2003). Open country birds such as starlings and grackles are also reported in diet studies (Bosakowski et al. 1992b) suggesting that Cooper's hawk forages in edge and open habitat as well as forested habitat. Cooper's hawk winter habitat is believed to be similar to breeding habitat (DeGraaf and Yamasaki 2001), though better quantitative data are needed. This raptor is frequently recorded in small numbers at winter bird feeding stations in New Hampshire (NHA website, undated).

1.2 Justification

Cooper's hawk is threatened in New Hampshire, though listing in several northeastern states may be a conservative response to limited data (Mosher 1989). Though data on historic abundance are equivocal, some posit large population declines of Cooper's hawk between the 1940s and 1970s due to DDT poisoning (Snyder et al. 1973). By these accounts, Cooper's hawk populations have partially recovered in some areas since the United States ban of DDT in 1972, but may remain below pre-DDT era levels throughout much of the east (Robbins et al. 1986). Variations in recovery may be due to DDT poisoning of neotropical migratory birds, a major component of the Cooper's hawk prey base (NatureServe 2005).

Cooper's hawk is also threatened in New Hampshire by habitat loss and parceling of forestland (Frieswyk and Widmann 2000), though recent work on nesting Cooper's hawk has noted successful breeding in smaller-sized pine plantations in Wisconsin (Rosenfield et al. 2000) and in urban/suburban areas in Arizona (Boal and Mannan 1998) and Pennsylvania (McConnell 2003).

1.3 Protection and Regulatory Status

Cooper's hawk is protected under the Migratory Bird Treaty Act of 1918.

1.4 Population and Habitat Distribution

Cooper's hawk was common in New Hampshire in the 1800s and 1900s (Elkins in Foss 1994). Pesticide poisoning probably contributed to a population decline throughout the eastern United States. Though first detected during migration counts in the 1960s, it probably began before 1950 (Bednarz et al. 1990). The Atlas of Breeding Birds in New Hampshire reports only 2 successful nests and 4 locations of territorial pairs from 1980 to1987 (Elkins in Foss 1994). There are insufficient data on Cooper's hawk to accurately estimate its abundance and distribution in New Hampshire.

The latest Breeding Bird Survey (BBS) summary reports a non-significant positive trend (1.2 percent) for Cooper's hawk in New Hampshire from 1966 to 2003 (Sauer 2004). However, BBS data need to be interpreted with caution, as roadside surveys may fail to encounter some elusive raptor species. Cooper's hawk migration counts at Hawk Mountain in Pennsylvania generally show an increasing trend beginning in 1963 (Mosher 1989, Bednarz et al. 1990).

1.5 Town Distribution Map

There are insufficient data available to map current Cooper's hawk distribution in New Hampshire.

1.6 Habitat Map

There are insufficient data available to map Cooper's hawk habitat in New Hampshire, although suitable habitat may be available in forested stands and suburban/urban wooded areas throughout the state.

1.7 Sources of Information

Information on Cooper's hawk habitat, population distribution, and status was compiled from scientific literature and limited agency and non-government organization information.

1.8 Extent and Quality of Data

There are no systematic sampling efforts to assess Cooper's hawk demographics in New Hampshire.

1.9 Distribution Research

- Collect information on the demographics of Cooper's hawk throughout the state during the breeding season in extensive forested habitat, suburban, and urban areas
- Develop a regionally viable broadcast survey to monitor areas for occupancy, detect changes in distribution and abundance, and determine nest locations. Broadcast surveys are time consuming and labor intensive and should be designed to be economical.
- Solicit information from the public on current and historic Cooper's hawk nest sites in the state. Potential sources include New Hampshire Bird list serve subscribers and spring turkey hunters.
- Develop a survey (or consult New Hampshire Bird list serve subscribers, Christmas Bird counts, and NHA feeder watch surveys) to determine Cooper's hawk winter demographics

Element 2: Species/Habitat Condition

2.1 Scale

Cooper's hawk occurs across the state. Potential conservation planning units at the section (M212A, M212B, and 221A) or subsection level appear to be most appropriate (Avers et al. (1994).

2.2 Relative Health of Populations

There are no data available to describe the relative abundance of Cooper's hawk in New Hampshire.

2.3 Population Management Status

There are no population management efforts for Cooper's hawk in New Hampshire.

2.4 Relative Quality of Habitat Patches

There are no data available for meaningful analysis.

2.5 Habitat Patch Protection Status

Cooper's hawk nesting areas on the WMNF and other conservation lands in New Hampshire will retain their nesting potential. Nesting potential on non-conservation lands and in urban/suburban areas will depend on whether these lands remain forested.

2.6 Habitat Management Status

There are no habitat management or restoration efforts for Cooper's hawk in New Hampshire.

2.7 Sources of Information

There are no statewide or regional data upon which to assess the condition of Cooper's hawk.

2.8 Extent and Quality of Data

There are no data available with which to make this assessment.

2.9 Condition Ranking

There are no data in New Hampshire with which to attempt condition ranking.

2.10 Condition Assessment Research

- Characterize breeding and foraging habitat at landscape, stand, and within-stand scales
- Determine how changes in forest structure and landscape patterns affect Cooper's hawk reproductive success, survival rates, territory fidelity, juvenile dispersal, and breeding dispersal
- Determine important prey species of Cooper's hawk and their response to fluctuations in prey availability across differently managed landscapes
- Continue long-term migration counts in order to detect changes in regional abundance patterns
- Characterize Cooper's hawk winter habitat

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
Land conversion—such as commercial and residential development—can compromise Cooper's hawk by reducing the number and distribution of available nest sites, foraging habitat, and important prey species. Outside of New Hampshire, Cooper's hawk successfully breeds in small isolated woodlots and in urban areas. Raptors nesting in these types of landscapes are exposed to additional environmental threats such as electrocutions, poisonings, exotic diseases, and collisions with windows and vehicles (Boal and Mannan 1999). Development can also increase populations of Cooper's hawk predators such as raccoons and great horned owls.

(B) Evidence
Forestland in New Hampshire has been declining at an annual rate of 2.7% since 1983 (Frieswyk and Widmann 2000). Development and changing ownership divide forest into smaller parcels and can introduce new sources of injury and mortality (e.g., collisions with windows and vehicles, electrocutions, poisonings, exotic diseases, and subsidized predators).

3.1.2 Non-Point Source Pollution (Chemical Contaminants)

(A) Exposure pathway
The use of chlorinated hydrocarbons such as DDT has been correlated with eggshell thinning in raptors, which leads to lowered reproductive success. Several studies implicate DDT and DDE as the contaminant that once threatened Cooper's hawk (Snyder et al. 1973, Pattee et al. 1985). Acutely toxic organophosphate pesticides may pose a more severe threat in urban areas and agricultural areas (Boal and Mannan 1999, Henny et al. 1985), but there have been minimal efforts to monitor poisonings in dead raptors (NatureServe 2005).

(B) Evidence
The use of DDT is linked to the decline of the Cooper's hawk between the 1940s and the 1970s. Although DDT has been banned in the U.S. since 1972, it is still used on the wintering grounds of many prey species of Cooper's hawk (NatureServe 2005). Effects of this are still unclear. Limited mortality monitoring occurs for most raptor species, so there is much speculation and little evidence of pesticide and contaminant threat.

3.1.3. Disease

(A) Exposure pathway
West Nile Virus (WNV) is carried in birds and is spread through the bite of infected mosquitoes, often causing encephalitis and/or meningitis. It was first detected in the United States in 1999 and is now

found in all of the lower 48 states. Corvids and, more recently, raptors appear to be particularly susceptible to the disease (Gancz et al. 2002).

(B) Evidence
The Raptor Center at the University of Minnesota positively demonstrated WNV in a sample of *Buteo jamaicensis* and Cooper's hawk (Wünschmann et al. 2004). The Raptor Center had admitted 71 raptors with the virus in 2002, of which 60 succumbed to WNV. *Bubo virginianus, B. jamaicensis*, and Cooper's hawk, have been hardest hit in Minnesota. The New Hampshire Department of Health and Human Services has limited their collection of dead birds for WNV testing to crows and blue jays, so it is difficult to determine whether raptors in New Hampshire have yet been exposed to WNV.

3.2 Sources of Information

Information on threats to Cooper's hawk came mainly from a review of research conducted outside of the northeastern United States.

3.3 Extent and Quality of Data

Most data on threats to *Cooper's hawk* come from areas outside of the northeastern United States and may not apply to the New Hampshire population Little is known of *Cooper's hawk* tolerance to habitat fragmentation, human disturbance, various forest management practices, or pesticide use in the United States and Central America.

3.4 Threat Assessment Research

- Compare productivity between Cooper's hawk populations in suburban/urban areas and within extensive forested areas
- Measure impacts of human disturbance (e.g., recreation, logging, urban/suburban obstacles [windows, powerlines, vehicles]) on Cooper's hawk productivity
- Identify effects of various forest management practices on reproductive success, nest site fidelity, and prey availability
- Determine if DDT and contaminants are still harming Cooper's hawk productivity
- Determine what effects West Nile Virus may be having on Cooper's hawk populations in New Hampshire.

Element 4: Conservation Actions

Habitat use, abundance, and distribution data necessary for Cooper's hawk conservation do not exist.

4.1.1 Developing occurrence, habitat and distribution data, Restoration and Management.

(A) Habitat Loss

(B) Justification
Statewide surveys will provide distribution and habitat data upon which population analyses can be conducted. Investigations that increase knowledge of Cooper's hawk demographics and habitat allow for better management.

(C) Conservation Performance Objective
Census surveys will test hypotheses of habitat conversion effects and will better determine the status of this state threatened species. Successful survey protocols will help correctly identify Cooper's hawk habitat and will offer the opportunity to sample live birds for contaminants and WNV exposure.

(D) Performance Monitoring
There is no statewide or regional monitoring of Cooper's hawk.

(E) Ecological Response Objective
There are no data available with which to formulate an ecological response objective.

(F) Response Monitoring
There is no monitoring of Cooper's hawk. Before conservation can occur, surveys of potential habitat must be conducted.

(G) Implementation
There are opportunities to partner with USDA Forest Service, UNH, United States Department of the Interior Fish and Wildlife Service, industrial forestry concerns, New Hampshire Division of Forest and Lands, NHNHB, local land trusts, and NHA to test any systematic survey protocol state-wide, and to further extend population and habitat research being

conducted by USDA Forest Service, Northeastern Research Station state-wide.

(H) Feasibility
Much cooperation and coordination would be required to accomplish a more systematic approach statewide, but it could be accomplished with adequate funding and commitment of personnel and resources.

4.2 Conservation Action Research

Continue monitoring forest raptor populations and habitat in the White Mountains region. Expanding these efforts state-wide would allow the direct testing of the habitat conversion/alteration hypothesis, as well as provide the opportunity to survey for WNV in live raptor populations. Such surveys and habitat assessments are needed to better describe the status of Cooper's hawk and its critical habitats and threats.

Element 5: References

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SPECIES PROFILE

Great Blue Heron

Ardea herodias

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S4B
Author: Jillian R. Kelly, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Great blue herons breed and nest in fresh and saltwater habitats that include marshes, beaver impoundments, wet meadows, estuaries, tidal flats, sandbars, shallow bays and the margins of lakes, ponds, streams and rivers (DeGraaf and Yamasaki 2001). Nests are commonly found in riparian swamps in dead trees 5 to 15 m above ground (NatureServe 2005, Ogden 1978, McAloney 1973, Vermeer 1969). Great blue herons often nest in colonies or rookeries.

Great blue heron foraging habitat includes freshwater and brackish marsh lakeshores, rivers, bays, lagoons, ocean beaches, mangroves, fields, and meadows (NatureServe 2005). Herons commonly feed on aquatic and terrestrial insects, fish, amphibians, reptiles, crustaceans, and occasionally on small birds and mammals (Short and Cooper 1985).

1.2 Justification

Great blue herons are sensitive to habitat loss and disturbance. For example, loss of nesting habitat, deterioration of water quality, and loss of wetlands can threaten herons (Short and Cooper 1985, Thompson 1979, Kelsall and Simpson 1980, McCrimmon 1981). Thus, herons can indicate changes in the environment. Specifically, heron populations can provide an indication of water quality and wetland health. Because pesticides and heavy metals accumulate in herons' primary prey, contaminated herons can indicate wider contamination of amphibians and fish.

Development and associated human disturbance also threaten great blue heron populations. For example, fledgling success depends on the success of the parents in providing sufficient food when nestlings are 2-6 weeks old (NatureServe 2005). Therefore, extensive disturbance, or loss of foraging habitat, directly reduces heron productivity.
Maintaining habitat for herons will also benefit animals such as osprey (*Pandion halaetus*), great horned owls (*Bubo virginianus*), amphibians, and fish. For example, heron rookeries are associated with potential nesting location of the state threatened osprey. Therefore, monitoring heron rookery locations can aid in identifying present and potential osprey nesting locations.

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act (1918).
- State wetlands regulations (see Marsh and Shrub Wetland habitat profile).

1.4 Population and Habitat Distribution

The great blue heron is the most common of New Hampshire's herons and occurs throughout the state (Elkins and Swift 1994). Based on the number of documented occurrences in the Breeding Bird Atlas, herons appear to be more numerous in southern New Hampshire than in the White Mountains and northern New Hampshire.

Because great blue herons often nest and forage in beaver (*Castor canadensis*) impoundments, local heron populations may fluctuate with beaver populations. For example, heron use of beaver ponds is now rebounding from the extirpation of beavers in the nineteenth century (Elkins and Swift 1994). The heron recolonization of beaver impoundments since the 1930s suggests that herons may be more numerous now than 50 or 100 years ago (Elkins and Swift 1994). During the 1990s, it was estimated that New Hampshire had approximately 200 heron rookeries, supporting around 1,600 pairs of herons (Hunt 2005). Great blue heron populations are believed to be increasing or stable in New Hampshire (Hunt 2005).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Marsh and Shrub Wetlands habitat profile element 1.6.

1.7 Sources of Information

Sources of information include the NatureServe database (2005), literature review, expert review and consultation (M. Marchand, Wetlands Biologist, NHFG), and the rare species and natural community database maintained by NHNHB.

1.8 Extent and Quality of Data

Data on the distribution of great blue heron in New Hampshire are limited, as is local and statewide information on population trends. Many records are missing from occurrence data collected as part of the Breeding Bird Atlas and maintained in the New Hampshire rare species database (Elkins and Swift in Foss 1994, C. Martin, NHA, personal communication).

1.9 Distribution Research

More information is needed on habitat use and population fluctuations at known rookeries (e.g., long term monitoring of identified large rookeries). More information on rookeries would also help in monitoring populations and identifying new osprey nesting locations. Newly identified rookeries should be incorporated into NHDES wetland permit reviews.

Element 3: Species Threat Assessment

See Marsh and Shrub Wetlands habitat profile for habitat-based threats.

Element 4: Conservation Actions

See Marsh and Shrub Wetlands habitat profile for habitat-based conservation strategies.

Element 5: References

5.1 Literature Cited

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5.2 Data Sources

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SPECIES PROFILE

Golden Eagle

Aquila chrysaetos

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G4
State Rank: SHB
Author: Carol R. Foss, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat description

Golden eagles inhabit remote mountainous areas with one or more cliffs suitable for nesting, abundant wetlands, and minimal human activity within 50 to 100 square miles (Spofford 1971). In Maine, 8 of 12 historical nest sites had a heronry within 20 km; a heronry was located within 35 km of the remaining sites (Weik 1987).

1.2 Justification

Successful breeding has not been documented in New Hampshire since 1956, although the last known home range was occupied until 1982 (W. Spofford, personal communication). Quebec populations in the Laurentian Mountains and on the Gaspe Peninsula (Environment Canada 2004) may provide a source for recolonizing potential breeding habitats in the White Mountains Ecoregion. However, potential habitats may be marginally suitable given human access to formerly remote areas, increasing recreational activity, contamination of surface waters by air-borne pollutants, and historical reductions of beavers and great blue herons in the region.

1.3 Protection and Regulatory Status

The golden eagle is protected in the United States under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712; Ch. 128; 13 July 1918; 40 Stat. 755) as amended by: Chapter 634; 20 June 20 1936; 49 Stat. 1556; P.L. 86-732; 8 September 1960; 74 Stat. 866; P.L. 90-578; 17 October 17 1968; 82 Stat. 1118; P.L. 91-135; 5 December 1969; 83 Stat. 282; P.L. 93-300; 1 June 1974; 88 Stat. 190; P.L. 95-616; 8 November 1978; 92 Stat. 3111; P.L. 99-645; 10 November 1986; 100 Stat. 3590 and P.L. 105-312; 30 October 1998; 112 Stat. 2956) and the Bald Eagle Protection Act (16 U.S.C. §§ 668-668d, 8 June 1940, as amended 1959, 1962, 1972, and 1978). This species is listed as Endangered in New Hampshire.

1.4 Population and Habitat Distribution

Known records of nesting in New Hampshire predate 1855 (Allen 1903). Three currently unoccupied historic nesting locations are known in the state, 2 in the White Mountains and one in the Lake Umbagog region (Allen 1903, Brewster 1925). The New Hampshire Bird Records Database for 1990 to 2004 includes documentation for 1 to 5 golden eagle sightings annually during fall migration (except 2002), single sightings during spring migration in 4 scattered years, and single July sightings in 1991 and 1998.

1.5 Town Distribution Map

There are no recent breeding records of golden eagles in New Hampshire.

1.6 Habitat Map
See the Habitat Map for Cliffs.

1.7 Sources of Information

Information was obtained from a literature review and from the New Hampshire Bird Records Database.

1.8 Extent and Quality of Data

Existing recent data consist of unverified reports to New Hampshire Bird Records. Reports of this species require thorough documentation and any consistent breeding season reports would be subject to field verification.

1.9 Distribution Research

Notify staff and volunteer peregrine falcon observers regarding the potential for golden eagle sightings, provide identification information, and request detailed observation and documentation of any eagles observed in vicinity of potential aeries.

Element 5: References

5.1 Literature

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5.2 Data Sources

New Hampshire Bird Records Database

SPECIES PROFILE

Golden-winged Warbler

Vermivora chrysoptera

Federal Listing: Species of concern
State Listing: Species of conservation concern
Global Rank: G4
State Rank: S2B
Author: Rebecca W. Suomala, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

The Golden-winged Warbler prefers early successional habitats such as pastures reverting to woodland, brushy fields, marshes, bogs, stream borders, powerlines, and openings in deciduous woods (Confer 1992, Curson et al. 1994). In New Hampshire, most breeding-season records have been in abandoned fields or clearcuts in an early stage of succession and along powerlines. According to Confer (1992), Golden-winged Warbler nesting territories are consistently found in habitat with patches of herbs, shrubs and scattered trees with a forested edge.

1.2 Justification

Considered rare in the early 1900s, the species expanded its range northward and eastward in response to farmland abandonment (Dunn and Garrett 1997). It began declining in the latter half of the 1900s and by the 1990s populations had decreased in 9 of 12 states (Confer 1992). The Breeding Bird Survey (BBS) data through 2003 show that the Golden-winged Warbler has declined by 8.3% in the USFWS's Region 5 (Sauer et al. 2004). Canada shows an increase on the BBS, although the trend is not significant (Sauer et al. 2004), and northeastern New York and central Ontario appear to have an expanding population (Confer 1992). Interim results on the New York Breeding Bird Atlas web site show only one small section of the state with an increased distribution and the majority of the state with a dramatic decrease when compared with the first Atlas in the 1980s (NYSDEC 2004). The overall regional pattern corresponds with a gradual northward shift in the species range (Dunn and Garrett 1997).

Golden-winged Warblers established breeding populations in the southeastern coastal plain of New Hampshire by early to mid-1900s (Foss 1994, Donsker 2004). In the 1950s through the mid-1970s, up to 10 individuals were reported in New Hampshire nearly every year, but that number has declined to less than five individuals annually between 1988 and 2003 (figure 1), with none reported in six of those years (Donsker 2004). There were only two breeding-season Golden-winged Warbler reports in 2000, one in 2001, and none in 2002-2004. The only reports from 2003 and 2004 were both likely migrants, one from Sandwich and one from Epping, respectively.

The Golden-winged Warbler is on the Partners in Flight Watch List and is one of 28 species in need of immediate conservation attention in the continental United States and Canada due to multiple causes for concern across its entire range (Rich et al. 2004). Reasons for the decline are not clear, but its early successional habitat has declined in the Northeast.

1.3 Protection and Regulatory Status

The Golden-winged Warbler is classified as a species of concern by the USFWS (Confer 1992), and is listed on the Partners in Flight Watch List (Rich et al. 2004), and on the Audubon Society's WatchList (National Audubon 2002). Along with most birds, it is protected more generally under the Migratory Bird Treaty Act, which prevents the killing of most nongame birds and collection of their nests or eggs.

1.4 Population and Habitat Distribution

New Hampshire is at the northeastern edge of the species' range in New England. There was only one record during the Maine Breeding Bird Atlas (Adamus 1983) and it is considered uncommon and declining in Massachusetts (Veit and Peterson, 1993). Most Golden-winged Warbler reported were from southeastern New Hampshire in the early 1980s, particularly Durham, Kensington, Exeter, and Newmarket. The primary locations with multiple reports over the years were Foss Farm, Longmarsh Road, and Packer's Falls Road in Durham, and South Road and North Road in Kensington. Only two locations in these four towns had sightings after 1995: Packer's Fall Road (through 1997), and Bald Hill Road in Newmarket (one report in 2000). The most recent sighting from the southeastern portion of the state during the breeding season was a male in July 2001 along a Northwood powerline. This was most likely a breeding individual and illustrates the potential for this species to occur at inaccessible locations along powerlines. There were also single sightings from seven other southeastern towns: Deerfield (1982), Dover (1984), East Kingston (1983), Hampstead (1999), Hollis (1997), Portsmouth (1996), and South Hampton (1986). There are only two locations outside of southeast New Hampshire where birds were reported regularly:

- Hanover: Goodfellow Road , reported annually from 1991-1997, with two nests in 1992 (although each was paired with a Blue-winged Warbler), and a pair carrying nesting material in 1993 (both Golden-winged Warblers).
- Weare/Dunbarton: Clough State Park and vicinity (a male in 2000, 1997, 1996, 1995). This is a location with many Blue-winged Warblers.

Three other locations had reports from two different years: Fox State Forest in Hillsborough (1985, 1996), Pisgah State Park in Winchester (1982, 1993), and Pembroke Academy area in Pembroke (1997, 1999). The other eight reports away from the southeast are single sightings from scattered locations as far north as Jefferson, none more recent than 1996. Infrequency of the reports may suggest rarity because many of the areas are regularly surveyed.

1.5 Town Distribution Map
Not completed for this species.

1.6 Habitat Map
N/A

1.7 Sources of Information

Species information was compiled from the pertinent literature. Information on the location of Golden-winged Warblers in the state refers to the period from 1980 through 2004. Only those sightings that represented potential breeding reports were included and those that were most likely migrants are not included unless specifically stated. The primary data source was NHBR with a few reports from the New Hampshire Breeding Bird Atlas (BBA) and the Breeding Bird Survey. There have been no organized survey efforts for this species in the state.

1.8 Extent and Quality of Data

Birders seek Golden-winged Warblers and sightings are likely to be included in NHBR. Many locations where the species was formerly found are still birded regularly, and some sightings were from locations where active reporters still reside.

1.9 Distribution Research

It is important to know if and where breeding Golden-winged Warblers remain in the state so that critical areas can be protected. Surveys should focus on historic locations and nearby suitable habitat. Surveys should also document the distribution of Blue-winged Warblers and Blue-winged Warbler/Golden-winged Warbler hybrids (see section 2.2).

Element 2: Species/Habitat Condition

2.1 Scale

The absence of currently breeding individuals in the state and the regional northward expansion of this species' range make it difficult to establish any appropriate conservation planning units.

2.2 Relative Health of Populations

After the early 1980s Golden-winged Warbler reports declined in number and regularity, with none in 1986-1988, few in the 1990s with the exception of the remarkable record year in 1996 (figure 1), and two during 2000-2004 (note that 1996 was also a record year for Blue-winged Warblers and their hybrids.) The number of Blue-winged Warblers and their distribution in the state has increased rather dramatically during the same period that Golden-winged Warblers have declined (figure 1).

Hybridization between Blue-winged and Golden-winged Warblers has been well documented in New Hampshire (NHBR). In 1992, two mixed pairs were documented in Hanover. One was a male Blue-winged with a female Golden-winged at a nest with four eggs that fledged successfully, and the other was a male Golden-winged with a female Blue-winged at a nest with three young that also fledged. The nests were relatively close to each other on opposite sides of the same road (NHBR). A male Golden-winged Warbler at Langmaid Farm in Durham was believed to nest with a female Blue-winged Warbler in June 1989 (NHBR). In South Hampton during the Breeding Bird Atlas, males of both species and both hybrids were singing in a clearcut, and in Kensington a territorial male Golden-winged Warbler was replaced first by a hybrid and then by a male Blue-winged Warbler in the space of one week during two different breeding seasons (Foss 1994). Details on all hybrid sightings are not included here.

Donsker (2004) summarized all New Hampshire reports of the two species and their hybrids, documenting the arrival of Blue-winged Warblers in 1955, their subsequent increase, the increase in hybrids, and the decline of Golden-winged Warblers (figure 1). The number of hybrids reported between 1999 and 2003 exceeds the number of Golden-winged Warblers reported, although reports of hybrids have declined in the last ten years, as might be expected given the decline of Golden-winged Warblers. The pattern of reports with increasing Blue-winged Warblers followed by "Brewster's" hybrids, declining Golden-winged Warblers and a few "Lawrence's" hybrids matches that described by Dunn and Garrett (1997). Over a 50-year time frame, this results in a population of entirely Blue-winged Warblers and an occasional "Lawrence's" hybrid.

2.3 Population Management Status

Golden-winged Warblers are not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

Current reports indicate that Golden-winged Warblers are no longer breeding in the state and that the quality of current habitat patches is difficult to evaluate.

2.5 Habitat Patch Protection Status
N/A

2.6 Habitat Management Status

There are no habitat management activities taking place for Golden-winged Warblers. There have been some efforts in the state to promote management of some lands for early successional habitat.

2.7 Sources of Information

Species information was compiled from the pertinent literature. Information on hybridization of Golden-winged Warblers with Blue-winged Warblers refers to the period from 1980 through 2004. The primary data source was NHBR with a few reports from the New Hampshire Breeding Bird Atlas (BBA) and the Breeding Bird Survey.

2.8 Extent and Quality of Data

The absence of Golden-winged Warblers in New Hampshire makes it difficult to evaluate the condition of existing habitat and whether habitat degradation was a factor in this species' disappearance from the state.

The presence of Blue-winged Warblers and the occurrence of hybridization with Golden-winged Warblers is adequately documented in New Hampshire by the current reports. Both species are popular among birders and there is awareness of the potential for hybridization such that reports of both these species and their hybrids are most likely to be included in NHBR.

2.9 Condition Assessment Research

- If any Golden-winged Warblers still breed in the state, it is critical to determine their productivity

and assess the habitat parameters, including presence of invasive species and the degree of fragmentation.
- Revisit historical locations to determine if habitat conditions are still suitable for Golden-winged Warblers

Element 3: Species and Habitat Threat Assessment

Threat assessment for Golden-winged Warbler is difficult because few individuals remain in the state. A description of broad-based threats that apply to the species as a whole are listed below, but which of these factors were the cause of Golden-winged Warbler decline in New Hampshire is not clear.

3.1.1. Altered Natural Disturbance (Natural Succession)

Development and the re-growth of forests on formerly open land has reduced early successional habitat throughout the Northeast (see Shrublands habitat profile).

3.1.2. Introduced Species, Development (Fragmentation), Predation and Herbivory

- Invasive species: In Michigan, the planting of non-native autumn-olives for game caused Golden-winged Warblers to disappear from formerly suitable shrub-habitat (Dunn and Garrett 1997). Autumn-olives are also known to invade fields in New Hampshire and their impact on Golden-winged Warblers is not known.
- Fragmentation: Golden-winged Warblers nest on the ground leaving them vulnerable to ground predators, especially in smaller patches where predators can more easily detect nests. Remaining patches of appropriate habitat, especially in the southern part of the state, are likely to be adjacent to suburbia where ground predators are more common. Nearby development or human disturbance may cause Golden-winged Warblers to abandon nests during nest construction or egg-laying, although they will remain on the nest once incubation starts, despite considerable disturbance (Confer 1992).

3.1.3. Scarcity (Competition)

Although Blue-winged Warblers appear to displace Golden-winged Warblers, this may be a result of habitat change and not competition. Local declines correlate with advancing succession and reforestation combined with Blue-winged Warbler range expansion (Confer 1992). Studies support Blue-winged Warbler dominance in some cases and Golden-winged Warbler dominance in others, but in areas of New York and New Jersey with suitable habitat, both species have coexisted for nearly 100 years (Confer 1992, Coker and Confer 1990). Brown-headed Cowbirds are known to parasitize Golden-winged Warblers and Confer (1992) reported that 30% of nests were parasitized out of several hundreds nests, but the effect on nest success was unknown.

3.2 Sources of Information

Pertinent literature was reviewed for determination of threats to the species as a whole. There is no state-specific information on these threats for New Hampshire, although the loss of early successional habitat is well known in the state (see habitat profile).

3.3 Extent and Quality of Data

Information on threats to the species as a whole is well described in the literature, but since Golden-winged Warbler is no longer present in the state, we do not know how each threat affects the species in New Hampshire.

3.4 Threat Assessment Research

More information is needed on the extent to which all threats listed above impact Golden-winged Warbler populations. Should any breeding Golden-winged Warblers remain, more information is needed on the effect of their interaction and hybridization with Blue-winged Warblers and its impact on the population.

Element 4: Conservation Actions

4.1. Regulation and Policy

Due to the dramatic decline of Golden-winged Warblers in the state, and especially the absence of reports since 2000, this species should be upgraded to Endangered in New Hampshire. The population may be beyond recovery in the state, but this is uncertain and results from inventory, research, and management efforts are needed to guide future status revisions. The absence of known breeding Golden-winged Warblers in the state precludes any further specific conservation actions.

4.2 Conservation Action Research

- Determine if habitat manipulation can attract Golden-winged Warblers to areas with past breeding-season reports and possibly restore the species.
- If any breeding individuals are found remaining in the state, there may be opportunities for research into habitat management regimes most beneficial for Golden-winged Warblers.

Element 5: References

5.1 Literature:

Adamus, P.R. 1983. Atlas of Breeding Birds in Maine, 1978-1983. Maine Department of Inland Fisheries and Wildlife, Augusta, Maine, USA.

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5.2 Data Sources

NHBR. New Hampshire Bird Records database and archives. New Hampshire Audubon, Concord, New Hampshire, USA.

Element 6: List of Figures

SPECIES PROFILE

Northern Goshawk

Accipiter gentilis

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3
Authors: Mariko Yamasaki and Christine, A. Costello, USDA Forest Service

Element 1: Distribution and Habitat

1.1 Habitat Description

Northern goshawk breeding home range consists of nesting areas, post-fledgling family areas, and foraging areas (Reynolds et al. 1992). All goshawk breeding activity, from courtship to fledging, centers around the nesting area, which includes the nest tree and surrounding stands that contain prey handling areas, perches, and roosts. In New Hampshire, white pine (*Pinus strobus*), paper birch (*Betula papyrifera*), yellow birch *(Betula alleghaniensis),* Big-toothed aspen *(Populus grandidentata),* and red maple *(Acer rubrum*) are common nesting trees. These stands tend to be mature, containing some large diameter trees, and have relatively dense canopies and open understories. Most have been somewhat disturbed. Nest sites are generally situated close to the bottom of gentle slopes, most below 1,500 ft.

Nests are constructed in large trees with dominant and co-dominant positions in the canopy, but are not necessarily the largest trees in the stand. A nest tree must contain a branching structure suitable for holding a large bulky stick nest. Goshawks will often maintain 1 to 8 alternate nests within their nesting areas (Yamasaki and Costello, unpublished data, Speiser and Bosakowski 1987, Reynolds et al. 1994). Nest trees are often situated close to some type of forest opening (e.g., small breaks in the canopy, trails, forest roads, and upland openings).

The post-fledgling-family area is the area surrounding the nest site used by both adults and juveniles after fledging and until juvenile independence (Reynolds et al. 1992). This area is similar to nesting habitat and is believed to be critical in providing extra cover and abundant prey for unskilled juveniles. Research from the western United States suggests that the post-fledgling-family area varies in size from 121 to 243 hectares (300 to 600 acres), probably due to variation in food availability (Reynolds et al. 1992, Kennedy et al. 1994, Daw and DeStefano 2001).

Goshawk foraging areas consist of large tracts of forestland containing a variety of forest age classes and openings that can support the diverse habitat requirements of important goshawk prey species (Reynolds et al. 1992). These species include ground and tree squirrels, game birds, medium to large-sized songbirds, corvids, rabbits, and hares (Reynolds et al. 1992, Bosakowski et al. 1992, Boal and Mannan 1994, Doyle and Smith 1994). Much research suggests that goshawks forage in closed canopy forests with open under stories where prey is accessible, but that younger stands and openings are important for prey production. Critical winter goshawk habitat in eastern North America is unknown.

1.2 Justification

Concern exists for the goshawk because of their association with large tracts of forests that are being converted to other uses in New Hampshire. New Hampshire is the fastest growing state in New England, and forestland has declined by 134,500 acres (2.7 percent) since 1983. Southern New Hampshire has experienced the greatest decline (Frieswyk and Widmann 2000). Development and changes in ownership divide forest into smaller parcels, compromising goshawks by reducing the availability of nest sites and prey species. Fragmented landscapes may also increase competition with other raptors such as great horned owls and red tailed hawks, which are better adapted to foraging and nesting in these areas (Crocker-Bedford 1990). Current habitat management guidelines were developed in other regions and are not applicable here due to differences in land-use patterns, forest cover type, disturbance regimes and available prey species.

1.3 Protection and Regulatory Status

Goshawks are protected under the Migratory Bird Treaty Act of 1918.

1.4 Population and Habitat Distribution

Goshawks breed throughout New Hampshire (Janeway in Foss 1994), though data on population dynamics are lacking. Passenger pigeon extirpation and extensive land clearing in the nineteenth century likely caused goshawk populations to decline, but subsequent agriculture abandonment and reforestation have likely contributed to a goshawk range and population expansion (Bent 1937, DeGraaf and Yamasaki 2001, Speiser and Bosakowski 1984, DeStefano in press).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Information on goshawk habitat, population distribution, and status was compiled from unpublished data from on-going research, scientific literature, limited agency data, surveillance of the New Hampshire bird list-serve, as well as from direct searches.

1.8 Extent and Quality of Data

There are no systematic goshawk sampling efforts in New Hampshire. Breeding bird surveys, hawk watches, and Christmas bird counts do not adequately survey for the seasonal and elusive goshawk. The objectives of current research efforts focused in the White Mountain region by the Northeastern Research Station are to locate breeding territories and describe nesting habitat and do not address demographics. Minimal funding results in inconsistent surveying and monitoring.

1.9 Distribution Research

- Develop a statewide broadcast monitoring program for goshawk that will be regionally viable. Although time consuming and labor intensive, broadcast surveys are the best method available and can be used to monitor areas for occupancy, changes in distribution and abundance, and nest location. Data on distribution are most essential in areas expected to experience the most severe habitat loss.
- Develop a survey method or make use of existing surveys (e.g., Christmas Bird Counts, Feeder Watches) to obtain an index of winter abundance and distribution in the state.
- Test a rapid assessment process developed by USDA Forest Service Wildlife Ecology Unit (Hargis and Woodbridge in press) in New Hampshire and the northeastern United States.

Element 2: Species/Habitat Condition

2.1 Scale

Goshawk occurs across the state. Potential conservation planning units at the section (M212A, M212B, and 221A) or subsection level appear to be most appropriate (Avers et al. (1994).

2.2 Relative Health of Populations

There are no data on the abundance of goshawk in New Hampshire.

2.3 Population Management Status

There are no population management efforts in the state.

2.4 Relative Quality of Habitat Patches

There are no data for meaningful analysis.

2.5 Habitat Patch Protection Status

Goshawk nesting areas on the WMNF and other conservation lands in New Hampshire will remain protected. Nesting potential on non-conservation lands will depend on whether these lands remain forested.

2.6 Habitat Management Status

There are no habitat management or restoration efforts in New Hampshire.

2.7 Sources of Information

There are no statewide or regional data upon which to assess the condition of goshawk.

2.8 Extent and Quality of Data

There are no data available to make this assessment.

2.9 Condition Ranking

There are no data for this ranking.

2.10 Condition Assessment Research

- Determine home range sizes and characterize breeding and foraging habitat at landscape, stand, and within-stand scales.
- Determine how changes in forest structure and landscape patterns affect reproductive success, survival rates, territory fidelity, juvenile dispersal, and breeding dispersal
- Determine important prey species of goshawk in this region and determine how the abundance and availability of prey is influenced by forest structure, management practices, landscape patterns, and natural cycles
- Identify effects of various forest management practices on goshawk habitat, nest site fidelity, productivity, and prey availability
- Determine migratory status of goshawks breeding in New Hampshire and winter survival rates of adults and juveniles
- Characterize goshawk winter habitat
- Determine if West Nile Virus is affecting goshawk populations New Hampshire

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
Development reduces the number and distribution of available nest sites and foraging habitat. Additionally, these activities can increase populations of goshawk predators such as raccoons and great horned owls.

(B) Evidence
White pine and northern red oak can consistently be regenerated in outwash sand and gravel sites (Leak 1982). White pine stands are frequently used for nesting sites by goshawks, and these stands tend to have soils that are moderately to excessively well-drained, making them ideal for both residential and commercial development. Forest planners have expressed concern over the disproportionate conversion of white pine and red oak sites in the last 20 years (Cullen and Leak 1988).

3.2 Sources of Information

Information on threats to the northern goshawk came from a literature review of research conducted outside of the northeastern United States as well as from research conducted by the Northeastern Research Station in the White Mountain region, and personal communications.

3.3 Extent and Quality of Data

Most of the existing data on threats to the goshawk come from areas outside of the northeastern United States and may not be relevant due to differences in land-use, forest cover types, disturbance regimes, and available prey species. Not enough is known about best forest management practices within goshawk nesting habitat or about this raptor's tolerance to disturbance during the breeding season.

3.4 Threat Assessment Research

- Determine the effect of land conversion and consequent habitat loss on goshawk productivity in historical goshawk nesting areas (i.e., compare gos-

hawk productivity in areas where land conversion and parceling processes are minimal, such as the White Mountain National Forest, to areas where the rate of land conversion is high)
- Evaluate the relationships between timber harvesting practices and nesting habitat, post-fledgling-family habitat, and foraging habitat
- Determine effects of human disturbance in goshawk nesting areas during the breeding season
- Monitor the development of West Nile Virus in forest raptors such as goshawk

Element 4: Conservation Actions

4.1.1 Developing occurrence, habitat, and distribution data, Restoration and Management.

(A) Habitat Loss

(B) Justification

- State-wide surveys will provide distribution and habitat survey data upon which population analyses can be conducted
- Statewide surveys can be followed by closer investigation of hemlock-hardwood-pine, northern hardwood-conifer, Appalachian oak-pine, and lowland spruce-fir types
- Investigations that increase knowledge of goshawk demographics and habitat availability (or degradation) will allow for better management

(C) Conservation Performance Objective
Census surveys in likely habitat will provide more information on a poorly understood species and will allow testing of habitat alteration hypotheses. Ecological studies will help determine the urgency of threats to the goshawk.

(D) Performance Monitoring
There is no statewide or regional monitoring of goshawk. Before conservation can occur, surveys must establish species occurrence and must determine whether habitat alteration is a significant threat.

(E) Ecological Response Objective
There are no data with which to formulate any type of ecological response objective.

(F) Response Monitoring
There are no data with which to formulate any type of response monitoring.

(G) Implementation
There are opportunities to partner with USDA Forest Service, UNH, United States Department of the Interior Fish and Wildlife Service, industrial forestry concerns, New Hampshire Division of Forest and Lands, NHNHB, local land trusts, and NHA to test the rapid assessment protocol suggested by Hargis and Woodbridge (in press) state-wide. Opportunities also exist to extend population and habitat research being conducted by USDA Forest Service, Northeastern Research Station statewide.

(H) Feasibility
The USDA Forest Service and UNH wildlife faculty have been conducting low intensity, non-systematic goshawk surveys in likely habitats since 1995 in the White Mountains region. Much cooperation and coordination would be required to accomplish a more systematic approach statewide, but it could be accomplished with adequate funding and the commitment of personnel and resources.

4.2 Conservation Action Research

Continuing support for ongoing goshawk population and habitat work in the White Mountains region and expanding these efforts state-wide would allow the direct testing of the habitat alteration hypothesis. Such surveys and habitat assessments are needed to better describe the status of goshawk and the characteristics of those habitats where goshawk occurs (e.g., associated vegetative communities, habitat condition indicators, any positive or negative forest management and recreational threats to habitat).

Element 5: References

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SPECIES PROFILE

Grasshopper Sparrow

Ammodramus savannarum

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S1
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

In the eastern United States, grasshopper sparrows use dry fields with sparse grasses (usually bunch grasses) and weeds, few shrubs, and patches of bare ground. Although areas with more than 35% shrub cover are rarely used, a few scattered shrubs or other tall plants provide important song perches. Airports, abandoned agricultural fields, blueberry barrens, capped landfills, and sandplain grasslands provide suitable habitat (Vickery 1996). In many parts of the East, the species will also use reclaimed surface mines (Whitmore 1980).

The grasshopper sparrow prefers large fields over 40 ha (100 ac), although the species will use sites as small as 12 ha (30 ac). However, not all large grasslands may be used. In Maine, sparrows occupied only 50% of suitable sites over 100 ha (250 ac; Vickery et al. 1994), and in Massachusetts only 1% of hayfields and 8% of barrens over 64 ha (160 ac) were occupied (Vickery et al. 1994).

In the Midwest and Great Plains, grasshopper sparrows use smaller fields more regularly, but this may vary across regions (Helzner and Jelinski 1999, Heckert 1994, Davis 2004). Davis (2004) also determined that sparrows were less likely to occur in patches with a perimeter-area ratio less than 0.018 m/m^2. This result is corroborated by work in Minnesota where sparrow nests were more likely to be located at least 45 m from a forest edge (Johnson and Temple 1986).

Habitat in New Hampshire is generally of the sparse dry grassland type described above. It is possible that sparrow rarity, and the patchiness of available habitat in the Northeast, have been conflated with choosiness on the part of the bird. Indeed, near the core of its range, less suitable habitat is more often occupied.

1.2 Justification

Although never common in New Hampshire, grasshopper sparrows have declined significantly since the 1960s (Foss 1994, New Hampshire Bird Records (NHBR)). The species is now restricted to 5 sites, of which at least 3 are seldom used (table 1). Their peak distribution in the state probably corresponded to the height of forest clearing for agriculture. There are insufficient data from the Breeding Bird Survey (BBS) to evaluate grasshopper sparrow population trends in the last two decades.

The species is of conservation concern throughout the Northeast, where range contractions and declines have been observed since the mid-1900s (Laughlin and Kibbe 1985, Andrle and Carroll 1988, Zeranski and Baptist 1990, Veit and Petersen 1993). Breeding Bird Survey data indicate a range-wide decline of 3.9% per year, and a 4.9% annual decline in the Northeast (Sauer et al. 2004).

1.3 Protection and Regulatory Status

This species is federally protected by the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs. The New Hampshire Endangered Species Conservation Act (RSA 212) protects grasshopper sparrows.

1.4 Population and Habitat Distribution

Since the 1960s, most of New Hampshire's grasshopper sparrows have been sighted in the Merrimack Valley south of Concord and in the Great Bay area (figure 1). Records are scant in the southern Connecticut Valley and Pemigewasset Valley/Squam Lake areas, and many are of single non-breeding birds. The state probably supports roughly 25 pairs of sparrows, with 80% of these at the Concord and Keene Airports. The regional population numbers approximately 500, with most at 2 locations in Massachusetts (Jones et al. 2001).

1.5 Town Distribution Map
Not completed for this species.

1.6 Habitat Map

A habitat map for grasshopper sparrow was based on the overall habitat map for extensive grasslands developed by New Hampshire Fish and Game (J. Oehler personal communication) (see Extensive Grasslands habitat profile). Potential grasshopper sparrow habitat within the population of extensive grassland polygons was selected as follows:

- Only the southern half of the state was considered (south of White Mountains and Vermont Piedmont ecoregions)
- Sites with a perimeter-area ratio greater than 0.02 m/m^2 were eliminated based on the work of Helzer and Jelinski (1999)
- Remaining patches were placed in 1 of 3 size categories, in order of increasing suitability: (1) < 40 ha, (2) $\geq$ 40 ha and < 100 ha, (3) >100 ha
- Sites within the lower Connecticut River Valley (2 towns east of river, north to Claremont), Merrimack River Valley (2 towns to either side of river, north to Concord), and Seacoast (roughly the Coastal Lowlands ecoregion) were given priority, based on more regular historic and current records of grasshopper sparrows

Ideally, such a habitat model would also consider the type of soil underlying a grassland, since grasshopper sparrows tend to occupy sites growing on sandy or otherwise poor soils. However, because digital soils data are not available for all parts of the state, this feature was not included.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Data on grasshopper sparrow distribution in New Hampshire were compiled from NHBR, a database maintained by the New Hampshire Audubon.

1.8 Extent and Quality of Data

Because surveys of historic grasshopper sparrow locations have been conducted in recent years, our understanding of the species' abundance at known sites is relatively good. However, most of the state's airfields are closed to the public, and the "discovery" of the large population at the Keene Airport in 2003 is testament to the potentially large gaps in our knowledge of its statewide distribution.

1.9 Distribution Research

A comprehensive survey of suitable habitat (including area requirements)—particularly at airfields—in southern New Hampshire is needed. Such a survey should include ground inventories of potential habitat identified with maps and GIS. Sites identified using the habitat model described above should be given priority, as should airports, capped landfills, and other extensive areas of "disturbed" habitat that may not have been identified in the above model.

Element 2: Species/Habitat Condition

2.1 Scale

Based on the known distribution, it is reasonable to treat grasshopper sparrows at the scale of occupied (or potentially occupied) habitat patches. These are all discrete units on the landscape, and for known sites there is generally some information pertaining to the level and types of threats that occur there. Since these sites represent a wide variety of ownerships and management needs, they are best treated independently. The proposed conservation planning units for grasshopper sparrows in New Hampshire are as follows:

- Concord Airport, Concord
- Keene Airport, Swanzey
- Pease Tradeport, Portsmouth/Newington

- Manchester Landfill, Manchester
- Derry Landfill, Derry
- Cemetery Fields, Amherst
- Old Mill Road, Lee
- Anheuser-Busch fields, Merrimack
- Souhegan River Fields, Amherst

Two sites in the lower Merrimack River Valley that have been unoccupied since the early 1980s may still support suitable habitat and should be considered potential grasshopper sparrow sites. These sites are Manchester and Nashua airports.

2.2 Relative Health of Populations

Most grasshopper sparrow populations have not been sufficiently monitored to determine how they vary in size or productivity. Four sites (Concord, Pease, Anheuser-Busch, Cemetery Fields) have supported the species consistently for the last decade, and population estimates do not seem to vary (Hunt 2003). Although data are limited, it is suspected that the Keene Airport also fits in this category.

2.3 Population Management Status

Management is not occurring at the level of sparrow populations at any site in New Hampshire. See element 2.6 for status of habitat management activity at sites where the species occurs.

2.4 Relative Quality of Habitat Patches

Of the sites identified in section 2.1, Concord, Keene, and Pease airports are considered high quality. All contain extensive acreage of suitable grassland or grassy heath. Habitat management is already in place at Pease to benefit upland sandpipers, and the mowing schedule should benefit sparrows. As a result, the low numbers and sporadic occurrence of sparrows cannot be attributed to mowing. Mowing at the Concord airport does not currently occur during the sparrows' breeding season, nor does it occur at the most important sparrow areas at the Keene airport. However, alteration of the mowing regime in other areas of the Keene airfield would probably benefit the species. At 2 other reliable sparrow sites—Cemetery Fields and Anheuser-Busch—mowing does not interfere with sparrows. However, these 2 sites are relatively small and not as critical as the large airfields. The remaining small sites would benefit from altered mowing practices, and these may be relatively easy to implement at the capped landfills.

2.5 Habitat Patch Protection Status

None of the units defined in section 2.1 is protected. Grassland habitat protected by Great Bay National Wildlife Refuge is adjacent to that at the Pease Airfield, but grasshopper sparrows have not been documented there. Management agreements or memoranda of understanding are in place at the Concord and Pease airports and at Cemetery Fields.

2.6 Habitat Management Status

Most of the sites currently known to support grasshopper sparrow populations are managed in either a beneficial or neutral manner. Such activities include late mowing (Anheuser-Busch, Cemetery Fields, Concord Airport, parts of Keene Airport) and partial mowing timed to benefit upland sandpipers (Pease Tradeport). At Cemetery Fields, there is a Memorandum of Agreement between the Town of Amherst Cemetery Trustees and NHFG that allows the latter to manage the site in a manner beneficial to grasshopper sparrows. Specifically, each half of the site will be mowed on alternate years and mowing will not occur between 15 May and 7 August. The management agreement for the Concord Airport (Fuller et al. 2003) stipulates that safety areas at the airport not be mowed until after 1 October, and that adjacent areas be mowed every 3 years. Because of the poor conditions at this site, such a mowing regime is sufficient to prevent excessive invasion by woody shrubs. At Pease, mowing of safety zones is initiated before 1 May, but all remaining areas are not mowed until August or later. At the smaller sites such as capped landfills and old gravel pits, mowing is not currently done in a manner compatible with maintaining grasshopper sparrow populations, although at least 1 land manager (Manchester landfill) is amenable to implementing such management. Although areas of the Keene Airport that support the majority of its sparrow population are not mowed until late in the season, sparrows do use areas that are mowed more regularly. Implementation of a mowing protocol similar to that at Pease may ultimately benefit birds at

Keene without detracting from the airport's need to comply with safety regulations.

2.7 Sources of Information

General data on habitat condition for grasshopper sparrows were compiled from the literature. Information on management activity at specific sites was obtained through site visits, discussions with pertinent parties, or existing management plans or agreements.

2.8 Extent and Quality of Data

At sites where grasshopper sparrows have been actively monitored in the last decade, the data on population size and habitat condition are of relatively high quality. A thorough assessment of grasshopper sparrow status in New Hampshire will require access to large areas of suitable habitat that have not been surveyed, particularly larger airfields in the southern half of the state.

2.9 Condition Assessment Research

At sites where grasshopper sparrows are know to occur, monitoring will determine if management affects abundance and productivity. Mapping singing locations or territories can inform managers of which areas are being used and may help determine if birds are breeding or simply wandering among patches of habitat.

Element 5: References

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5.2 Data Sources:

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord, NH.

Element 6: List of Figures

Figure 1. Distribution of breeding season records of grasshopper sparrow in New Hampshire 1960-2004. Towns are coded according to the number of years in each period when sparrows were reported: yellow = 1, red = 2-5, black = > 5 (data from NHBR and Hunt 2003). Records of birds in late May but not later in the season are excluded as being possible migrants.

Table 1. Sites supporting grasshopper sparrows in at least 2 years during the period 1990 to 2004 (data from NHBR and Hunt 2003). Sites believed to support the species on a consistent basis are indicated with an asterisk.

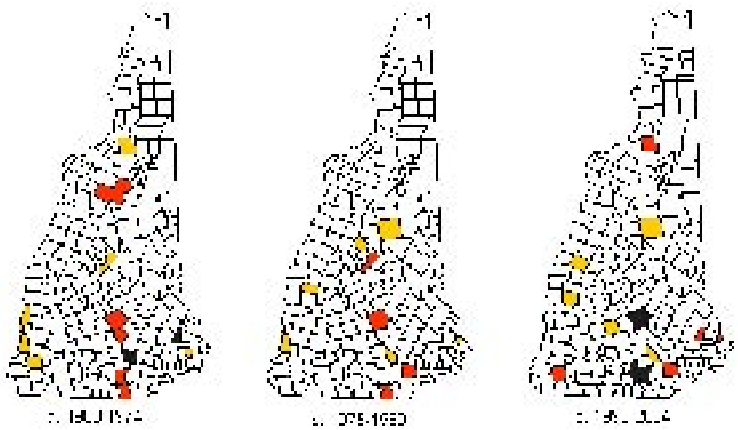

Figure 1. Distribution of breeding season records of grasshopper sparrow in New Hampshire 1960-2004. Towns are coded according to the number of years in each period when sparrows were reported: yellow = 1, red = 2-5, black = > 5 (data from NHBR and Hunt 2003). Records of birds in late May but not later in the season are excluded as being possible migrants.

Town	Site	Occupancy	abundance
Concord	Concord Airport*	1997 onward	10± pairs
Merrimack	Anheuser-Busch fields*	1996 onward	1-3 pairs
Amherst	Cemetery Fields*	1996 onward	1-2 pairs
Newington/ Portsmouth	Pease Airfield*	1995 onward	single males
Amherst	Souhegan River fields	1994,1999, 2003	male or pair
Derry	old landfill	1999 and 2003	single males
Lee	gravel pit on Old Mill Rd.	2001 and 2002	single males
Swanzey	Keene Airport*	2003 and 2004	10± pairs

Table 1. Sites supporting grasshopper sparrows in at least 2 years during the period 1990 to 2004 (data from NHBR and Hunt 2003). Sites believed to support the species on a consistent basis are indicated with an asterisk.

SPECIES PROFILE

Pied-billed Grebe

Podilymbus podiceps

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S1B
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Pied-billed grebes inhabit a range of wetlands, especially ponds or slow portions of streams with dense stands of emergent vegetation (Muller and Storer 1999). In the Northeast, they also appear to prefer areas with submerged aquatic beds (Gibbs et al. 1991). Nearby open water is needed for foraging and take-off prior to flight; sites in Maine averaged at least 34% open water (Gibbs et al. 1991). In Maine, most wetlands occupied by the species were those created by beavers (*Castor canadensis*) or by humans (Gibbs and Melvin 1992).

Two additional features appear critical in nest site selection: water depth of at least 25 cm (10 in) and emergent stem densities of at least 10 cm^2/m^2 (0.15 in^2/ft^2) in adjacent wetland patches (Muller and Storer 1999). Home range size is variable, and may depend on habitat type and quality. In the prairie pothole region, home ranges average between 1 and 3.5 ha (2.5-8.75 ac, Muller and Storer 1999). In Maine, however, grebes rarely breed in wetlands less than 5 ha (12 ac) in size (Gibbs et al. 1991, Gibbs and Melvin 1992), suggesting that home range needs may be larger in this part of the country. Alternatively, lower population densities in the Northeast may allow grebes to be more selective since available habitat is not saturated.

All sites in New Hampshire where the species has occurred regularly contain open water and surrounding cattail (*Typha* sp.) marsh and may include ponds or small lakes (Center Harbor, Jefferson, Lyman, Tuftonboro), beaver ponds (Nottingham, Hopkinton, Durham), fens or slow streams (Alton, Danbury, Pittsburg, Sutton), impoundments (Dummer, Peterborough, Springfield, Wentworth, Newington), sewage lagoons (Exeter, Rochester), and backwaters of larger lakes (Errol, Hebron). With the exception of sewage ponds, most pied-billed grebe habitat includes some woody vegetation such as alder (*Alnus* sp.) or buttonbush (*Cephalanthus occidentalis*).

1.2 Justification

Lacking consistent statewide coverage makes it difficult to evaluate changes in New Hampshire's pied-billed grebe population, although sighting data indicate a decline (Foss 1994, NHBR). The species has shown declines over much of its range elsewhere in the Northeast and is absent from large areas of apparently suitable habitat in Vermont (Laughlin and Kibbe 1985) and Massachusetts (Petersen and Meservey 2003). In New York, although declines have been noted (Andrle and Carroll 1988), recent atlas data do not suggest any change in the species' range, and it may even be increasing slightly (New York State Department of Environmental Conservation 2004). The latter trend may reflect a general increase in the central part of the of the species' range based on the BBS (see below). In addition, the loss and degradation of wetlands in most of New England make the species particularly vulnerable to decline.

Winter abundance data from the CBC (National Audubon Society 2002) suggest that grebe populations in the eastern United States have been stable or slightly increasing since the mid-1960s. The exception was a pronounced increase during the 1990s that was followed by a consistent decline between 2000 and 2004. The latter has resulted in grebes returning to pre-increase levels or slightly higher along the

Gulf and South Atlantic coasts. Grebes are probably better surveyed than many other species on the CBC, so these broad regional trends may accurately reflect trends in breeding populations, and in this case corroborate the increases noted by the BBS. However, such increases do not preclude declining populations in the Northeast (including New Hampshire), since the wintering locations of the region's breeding population are unknown.

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act (1918)
- New Hampshire Endangered Species Conservation Act (RSA 212A)
- See Marsh and Shrub Wetlands habitat profile for regulations pertaining to wetland habitats

1.4 Population and Habitat Distribution

The pied-billed grebe occurs throughout the state, but has always been rare and local in distribution (Foss 1994). Old regional ornithological works variously describe the species as a breeder, primarily a migrant, or absent, and a lack of comprehensive statewide coverage until relatively recently makes it difficult to ascribe any clear pattern to its distribution and abundance. Recent records of the species have come from all over the state, with the exception of the southwest and the White Mountains (figure 1). Within this range, there are 7 areas of more regular occurrence (see also elements 2.1 and 2.2):

- Extensive wetlands in Coos County
- Small wetlands in the Connecticut River valley between Hanover and Littleton
- Ponds around the northern portion of Lake Winnipesaukee
- Several larger wetlands in west-central New Hampshire (centered on northwestern Merrimack County)
- Upper Merrimack River Valley
- Southern Piscataquog River watershed
- Southeastern New Hampshire away from the immediate coast

Not all these areas have been occupied consistently, however, as a comparison of figures 1a and 1b indicates. Between 1984 and 1993, records were somewhat concentrated in regions 1, 3, 4, and 5, and between 1994 and 2003 most records were from regions 1, 4, 6, and 7. Over the last 25 years (figure 1c), only 7 sites (indicated by black towns) have been used consistently by pied-billed grebes. Even at these sites, there are few records from 2000 onward. Whether this paucity reflects the species' actual absence or simply a lack of coverage is unknown.

Grebes show a similarly patchy distribution elsewhere in New England. Massachusetts probably hosts fewer than 20 pairs (Petersen and Meservey 2004), and the species is absent from apparently suitable habitat in much of the Champlain Valley of Vermont (Laughlin and Kibbe 1985). Grebes are more common in Maine, where one study documented them in 17% of available wetlands (Gibbs et al. 1991) and in 22% of Breeding Bird Atlas blocks (Adamus 1988).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

A pied-billed grebe habitat model for New Hampshire was modified from a model developed by USFWS Gulf of Maine Project (Banner and Schaller 2001). An NHNHB composite wetland map provided the base map, in which contiguous wetlands were grouped into complexes and given attributes related to wetland size, proportions of different wetland types, and a number of additional variables related to threat and condition (see Marsh and Shrub Wetlands habitat profile). Potential grebe habitat was selected from the larger wetland data set using the following criteria ("wetlands" refers to "wetland complexes" as defined in the wetland habitat plan):

1. Elimination of all wetlands less than 5 hectares (12.5 acres).
2. Lacustrine wetlands (lakes: all wetland types beginning with "L") were added to adjacent wetlands in the New Hampshire Natural Heritage Inventory (NHNHI) wetland complex map. Three coverage values were recalculated for each resulting wetland:

a. Percent open water (lacustrine and "other," which includes wetlands coded as PAB and PUB)
b. Percent emergent marsh (PEM)
c. Percent shrub wetland (PSS)

d. Elimination of wetlands with less than 25% or greater than 90% open water
e. Elimination of wetlands with greater than 90% shrub
3. Wetlands greater than 10 hectares (25 acres) were given a higher ranking than wetlands less than 10 ha (as per Gibbs et al. 1991).

Of 50 pied-billed grebe sites in the NHNHI database, this model correctly identified 24. Several sites were not identified because they are located in semi-isolated wetlands connected to lakes or rivers. As a result, they were eliminated from the model at step 3. Other grebe locations not captured by the model include wetlands that were not identified by the National Wetland Inventory (NWI) maps, or wetlands whose current condition is different from that coded on the NWI maps. For instance, some sites currently contain an area of open water because of recent beaver activity, whereas the NWI maps indicate a continuous emergent marsh or shrub swamp. Because of the inaccuracies in the underlying NWI data, and difficulties related to wetlands associated with large water bodies, a modeling approach is not a valuable tool for identifying potential grebe habitat at this time.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Habitat modeling was informed by the Gulf of Maine Program (Banner and Schaller 2001) and wetland mapping conducted by NHNHB. Data on grebe distribution in New Hampshire were compiled from NHBR, a database maintained by NHA.

1.8 Extent and Quality of Data

Information on pied-billed grebe distribution in New Hampshire is limited by habitat inaccessibility and inconsistency of coverage. Because grebes have a history of both patchiness and site fidelity, the discontinuation of regular visits to a given site can significantly alter our broader knowledge of current statewide distribution. Thus, the absence of reports from a known breeding site cannot be taken as evidence of the species' absence.

1.9 Distribution Research

To fill the significant gaps in the knowledge of grebe distribution in New Hampshire, it would be valuable to implement a statewide monitoring program for this and other wetland birds. Surveys should target known or high-potential sites (as identified by habitat mapping) and use methods consistent with other efforts in the region. Marsh bird monitoring is a priority project in BCR 30, and a coordinated regional effort would be invaluable in understanding trends in distribution and abundance of this and other wetland species throughout the Northeast.

Element 2: Species/Habitat Condition

2.1 Scale

New Hampshire's known pied-billed grebe locations are here divided into three conservation units based on the type of management known to be in place and the potential for future management. The 24 recently active pied-billed grebe sites in New Hampshire were placed into one of these three categories based on available information (table 1). These three types are:

- **Impoundment-associated wetlands.** These wetlands are associated with some sort of water control structure, thus theoretically allowing water levels to be regulated. Included in the category are many Wildlife Management Areas, Lake Umbagog, Pontook Reservoir, and reservoirs associated with flood control projects.
- **Sewage ponds.** In some wastewater treatment facilities, ponds associated with certain stages of treatment contain emergent vegetation that mimics the structure of natural wetlands. Grebes have used such habitats in the past, and inactive sewage ponds may retain suitable habitat and thus the potential to attract grebes.
- **Natural wetlands.** All remaining wetlands in the state are in this category, which includes those associated with the backwaters of larger rivers (Reed's Marsh, Town?), beaver ponds (Nottingham, Durham), small ponds and lakes (Cherry Pond, Copp's Pond Towns?), and bogs and fens (Scott's Bog, Town?).

2.2 Relative Health of Populations

In the absence of consistent data, populations in a given unit can only be evaluated indirectly, through a combination of population persistence and the number of occupied sites within a unit. Table 1 includes all sites where grebes were reported during the breeding season in at least 2 different years within any 5-year period since 1980. Sites shaded gray meet the criteria of a) grebes present in at least 4 years since 1980, b) confirmed breeding in at least 1 year, and c) grebes present in at least 1 year since 1990. Sites are grouped by region as described in element 2.1.

Twelve sites meet these criteria and could thus be considered "priority" grebe locations in the state. Of these sites, only Copp's Pond, Cascade Marsh, the Rochester lagoons, and the Umbagog marshes have hosted more than a single pair of grebes in a given year, and even at these sites more than a single pair is rare. Potential sites identified through habitat mapping cannot be reliably evaluated for population health, although their overall condition can be assessed using the same geographic information system (GIS) methods as developed for wetland habitats as a whole.

2.3 Population Management Status

The pied-billed grebe is not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

There are no data with which habitat quality could be evaluated for this species. The habitat model, which generates scores from 0.5 to 1.5, could be used as an approximation of habitat quality on a statewide scale.

2.5 Habitat Patch Protection Status

Of the 24 recent locations for the species in table 1, 15 (62.5%) are protected in whole or in part by easement or fee-simple. Of protected areas, 7 are impoundments (conservation unit A) and 8 are natural wetlands (conservation unit B). Protected status of potential locations will be unknown until such locations have been identified.

2.6 Habitat Management Status

At Cascade Marsh, management of water levels to benefit pied-billed grebes has been in place since the 1980s (E. Robinson, New Hampshire Fish and Game (NHFG), personal communication). Water levels at this site are first lowered after ice goes out to levels suitable for grebes while still allowing for vegetation growth. This water level is maintained through the summer and is raised in September when grebes are no longer nesting. It is feasible to apply similar water level management at 3 additional grebe sites in State Wildlife Management Areas (Hirst, MacDaniel's Marsh, Danbury Bog; TOWNS?? E. Robinson, NHFG, personal communication).

2.7 Sources of Information

Data on site occupancy were compiled from NHBR. Information pertaining to management at some grebe sites (state wildlife management areas) was obtained from the NHFG (E. Robinson, NHFG, personal communication).

2.8 Extent and Quality of Data

As indicated above, data on pied-billed grebes and their habitat in New Hampshire are inconsistent. There are no data on management activity at the majority of sites where the species is known to occur.

2.9 Condition Assessment Research

In the absence of comprehensive information on grebe distribution in the state, any assessment of population/habitat condition would be premature. When grebe distribution is better understood, additional research will be useful in determining why apparently suitable potential habitat is unoccupied. However, even this research will need to consider the regionally low population size, because the species' absence from a site may just as easily reflect low colonization rates as low habitat quality.

Element 3: Species and Habitat Threat Assessment

3.1.1 Altered Hydrology (Water Withdrawal and Drawdowns)

A) Exposure Pathway
Many suitable wetlands are located above man-made dams. The purpose of such dams includes creation of impoundments for recreation, hydroelectric power, flood control, and wildlife management. If water levels rise or fall significantly during the nesting season, grebe nests may be flooded or grounded. Nest flooding is likely to result in either egg or nestling mortality and may cause adults to abandon the nest. If grebes do not abandon a nest after water levels fall, the nest may be more exposed to terrestrial predators. In either case, changes in vegetation following a change in water level may also make the nest more visible to predators.

B) Evidence
Although anecdotal evidence is conflicting, studies suggest that changing climatic conditions and variable water levels are to blame for a significant percentage of unsuccessful nests (Glover 1953, F. von Mertens, NHBR, observer, personal communication). These studies corroborate suspicions that lower water levels increase threats from terrestrial predators.

3.2 Sources of Information

Information on threats to pied-billed grebes was taken from the literature and from lists of threats developed as part of regional bird conservation planning (BCRs 14 and 30, etc.). Threats developed for Marsh and Shrub Wetlands profiles were also used with modification in development of the threat rankings for pied-billed grebe.

3.3 Extent and Quality of Data

In the absence of detailed study at the vast majority of pied-billed grebe breeding locations in New Hampshire, it is difficult to provide specifics on how any particular threat affects the species here. Data are similarly lacking on most potential broad-based threats.

3.4 Threat Assessment Research

Although various environmental pollutants have been proposed as threats to pied-billed grebes (Gibbs and Melvin 1992), there are few, if any, data on the presence and effects of such contaminants on grebe populations. Given increasing concern for the effects of mercury in other aquatic birds, it may be valuable to expand mercury research to grebes and other marsh-nesting birds.

Hunting and fishing in wetlands has the potential to introduce lead shot and sinkers where they may be ingested by grebes. However, ingestion and mortality have not been documented in pied-billed grebes or any other North American grebe species, though lead is recognized as a major source of mortality in loons and some fish-eating raptors (H. Vogel, Loon Preservation Committee, personal communication). Nonetheless, given the smaller size and secretive nature of grebes, mortality is almost certainly underdocumented.

Additional research is necessary on the effects of human disturbance, particularly that caused by small watercraft (larger and faster watercraft are less of an issue in areas used by grebes). There are currently few, if any, data on the incidence of nest abandonment or failure caused by such watercraft. In the absence of such data it is premature to propose conservation actions such as no-entry zones for this species. Finally, although grebes are known to use wetlands dominated by non-native, invasive plants (Esler 1992, Whitt et al. 1999), there are few data on their productivity in such habitats or on how regularly they are occupied.

Element 4: Conservation Actions

4.1.1: Stabilize water levels during the nesting season at reservoirs or impounded areas that support pied-billed grebes. This action fits within the "Restoration and Management" category, but also has elements of "Regulation and Policy," as follows. Appropriate water level management as described below should be instituted as a standard NHFG activity at state Wildlife Management Areas that support or potentially support grebes. It would also be beneficial to determine ownership and management policy of dams associated with other grebe sites, and to improve grebe nesting success at these locations.

A) Threat: Altered Hydrology

B) Justification
If water levels are maintained at levels present during nest initiation, the threat is eliminated, along with attendant stresses. The action can be implemented

at single locations where the threat can potentially occur

If the action is implemented at the appropriate time, the affected population will benefit immediately.

Given that water levels can be controlled, careful monitoring of both local conditions and the status of a grebe nesting attempt will allow for either additional adjustment of water level (e.g., if high rains cause water to rise) or cessation of the action (e.g., if the grebes abandon for other reasons and the action is no longer necessary)

C) Conservation Performance Objective

This action requires knowledge of the presence and potential breeding of pied-billed grebes at a location where water levels are subject to human manipulation. At the least, the potential for implementation of this action should be acknowledged at sites where it is possible and where there is a history of use by pied-billed grebes. This action will need to be implemented no later than completion of nest-building activity, when the position of the grebe nest above the bottom will be relatively fixed. Water levels will need to be maintained at that level until the young grebes have left, or are likely to have left, the nest.

D) Performance Monitoring

Implementation of this action can be monitored by checking water levels over the course of the breeding season. With the exception of rain-induced flooding (see below), there should be no significant changes in water level between May and September.

E) Ecological Response Objective

Increase likelihood that grebes nesting in impounded areas produce young. Increased productivity in turn increases the pool of potential recruits into the New Hampshire breeding population.

F) Response Monitoring

In addition to local monitoring of productivity at action sites, it will be necessary to continue monitoring grebes at a broader scale to determine if there are any effects on the statewide population. Such monitoring could be more intensive at suitable wetlands closer to the implementation site (although there are no data on natal dispersal distances in this species).

G) ImplementationAt the one site where this action has been implemented (Cascade Marsh Wildlife Management Area, Sutton) water levels were lowered in April – after ice out – to levels suitable for pied-billed grebes. Although site-specific conditions may result in this level varying among sites, enough water should remain to allow for nest site selection (minimum 25 cm), foraging, and take off. At least 34% of the total wetland area should remain open water of sufficient depth.

Water levels should be maintained at this level through the summer and allowed to rise in September. Although this action maintains water level at a depth and extent suitable to grebes, it can be negated by rain that floods impounded areas too quickly for additional water to be released. Such events can destroy grebe nests or cause abandonment, but are beyond the scope of this action. Depending on location, implementation of this Action may require cooperation between state agencies (NHFG, Department of Environmental Services, Department of Resource and Economic Development), power companies, the USACE, and private citizens.

H) Feasibility

In most cases, the partnerships described above already exist in some form. In addition, this action is inexpensive. Where impoundments are associated with hydroelectric dams, maintenance of water levels may simply not be possible. Many impoundments are drawn down to during the summer to encourage vegetation that will provide food for waterfowl in the fall. When this was done at Cascade Marsh (Town?), increased vegetation did not deleteriously affect waterfowl habitat= (E. Robinson, NHFG, personal communication).

4.2 Conservation Action Research

Given the patchy distribution of pied-billed grebes in New Hampshire and the highly variable nature of the sites they occupy, it is not clear that any one conservation action will have a dramatic effect on the population. The majority of occupied sites are already conserved in some manner, and as a result the only broadly applicable conservation strategy is the maintenance of appropriate water levels at sites where this is possible. In light of this, the most important conservation action of this and other wetland birds in New Hampshire is the implementation of a standardized inventory and monitoring plan (coordinated on a regional scale). Such a program would provide much-needed information on distribution and population trends at a larger scale – a scale that is perhaps more indicative of the health of this species' population in the northeast. Once baseline data are collected, other conservation actions may be reconsidered.

Element 5: References

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Element 6: List of Figures

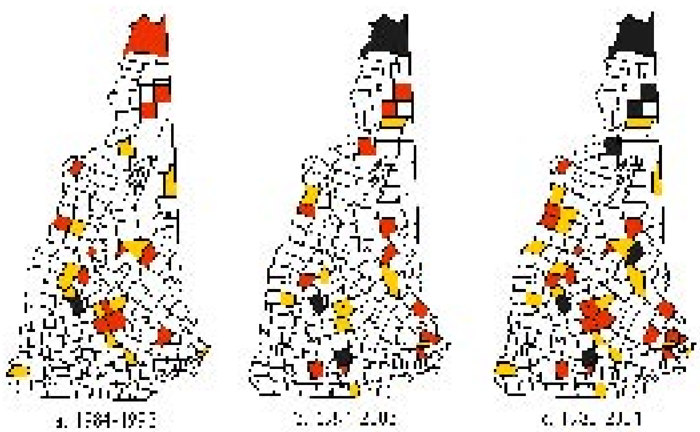

Figure 1

Table 1. Sites hosting pied-billed grebes in at least two years since 1980. See text for details.

Region/Town	Wetland	Conservation Unit Type (Section 2.1)	# years reported (1980-2004)	Most recent report	# probable or confirmed nestings
North Country			-29	-2002	-5
Dummer	Pontook Reservoir	A	9	2002	2
Errol	Lake Umbagog marshes	A	6	2001	1
Jefferson	Cherry Pond	C	6	2003	0
Pittsburg	East Inlet	C	8	2000	2
Central Connecticut Valley			-6	-1998	-3
Lyman	Dodge Pond	C	2	1986	2
Orford	Reed's Marsh	C	2	1991	1
Piermont	Lily Pond	C	2	1998	0
Lakes Region			-10	-1998	-5
Center Harbor	Winona R./L. Waukewan	C	2	1988	2
Tamworth	Hemingway Pond	C	2	1989	0
Tuftonboro	Copp's Pond	C	6	1998	3
West-Central Wetlands			-30	-2004	-16
Hebron	Hebron Marsh	C	2	1992	0
Danbury	Danbury Bog	A	3	2002	0
Springfield	MacDaniel's Marsh	A	4	1998	1
Sutton	Cascade Marsh	A	21	2004	15
Upper Merrimack Valley			(9+)	-2002	-4
Boscawen	Hirst WMA	A	4	1993	2
Concord	South End Marsh	C	2	1988	2
Hopkinton	Chase sanctuary	C	3+	2002	0
Piscataquog Watershed			(5+)	-2003	(3+)
Mont Vernon	Roby Pond	C	2	1997	2
New Boston	Great Meadow	C	3+	2003	1+
Coastal Wetlands			-20	-2004	-10
Durham	Packers Falls Road Marsh	C	4	2004	1
Exeter	Sewage ponds	B	5	2003	2
Newington	Stubb's Pond	A	3	2002	0
Nottingham	Rollin's Brook	C	4	1990	3
Rochester	Sewage ponds	B	4	1997	4

SPECIES PROFILE

Horned Lark

Eremophila alpestris

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3B
Author: Alina, J. Pyzikiewicz, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

The horned lark breeds in sparsely vegetated open lands that include airports, golf courses and cemeteries (MacLeod 1994, Beason 1995). Nest sites are on the ground beside grass, rocks, or wood that protect the nest from snowmelt and wind-blown snow (MacLeod 1994). Winter habitat is similar to breeding habitat, with the addition of beaches, dunes, and roadsides (when the ground is covered with snow) (MacLeod 1994, Beason 1995). Bare agricultural fields with ample seeds and insects provide year-round foraging and are augmented in winter by feedlots (Beason 1995, DeGraaf and Yamasaki 2001).

1.2 Justification

The horned lark has been slowly declining throughout its range, most noticeably in the Northeast, where farms and open land are forested and developed (Beason 1995, Vickery et al. 1999).

1.3 Protection and Regulatory Status

The horned lark is protected under the Migratory Bird Treaty Act and through grassland bird conservation programs (North American Bird Conservation Initiative, Partners in Flight Northeast Grassland Bird Working Group).

1.4 Population and Habitat Distribution

The horned lark can be found year-round in much of North America, with the exception of interior Canada, the Pacific Northwest, and the southeastern United States (Beason 1995). It is a breeding resident in Canada and Alaska and a permanent resident in the lower 48 states and Mexico (Ridgely et al. 2003).

In New Hampshire, historical records show that horned larks, most likely the northern subspecies (*E. a. alpestris*), bred in the White Mountains region and North Country and were uncommon in the south (MacLeod 1994). Horned larks nesting in the southern part of the state in the early 1900s were most likely the prairie subspecies (*E. a. praticola*) (MacLeod 1994). Between 1940 and 1970, horned larks sighted in winter were of the northern subspecies, and those sighted in summer were of the nesting prairie subspecies (MacLeod 1994). Current observations of breeding horned larks have been recorded at the Concord Municipal Airport, Lebanon Municipal Airport, Manchester Airport, Diliant Hopkins Airport, Pease International Air Force Base, Hampton Harbor Inlet, and Hampton Beach State Park (NHNHB 2005).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Extensive Grassland habitat profile.

1.7 Sources of Information

Sources of information included the NHNHB database, MacLoed (1994), Beason (1995), and DeGraaf and Yamasaki (2001).

1.8 Extent and Quality of Data

Horned lark habitat and population distribution is well studied throughout its range. Population data in New Hampshire are limited.

1.9 Distribution Research

- Identify and protect key grassland habitat areas
- Continue monitoring grassland habitats to better assess horned lark population declines
- Determine the status of population in New Hampshire's coastal dunes
- Determine effects of airport management techniques on populations that occur in such habitats.

Element 3: Species Threat Assessment

See Grasslands habitat profile.

Element 4: Conservation Actions

See Grasslands habitat profile.

Element 5: References

5.1 Literature

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SPECIES PROFILE

Least Bittern

Ixobrychus exilis

Federal Listing: Not listed
State Listing: Species of Special Concern
Global Rank: G5
State Rank: S1
Author: Kim A. Tuttle, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

The least bittern is the smallest member of the heron family. Its laterally compressed body, long toes, and curved claws are well suited to sliding through and grasping the stems of the tall, emergent vegetation where it often clings in order to fish over deep, open water (Gibbs et al. 1992). Least bitterns are associated with cattail (*Typha* spp.) marshes in northern regions, including managed impoundments, lake coves with stable water regimes, and occasionally sedgy bogs (Gibbs et al. 1992). It prefers freshwater or brackish marshes with scattered woody vegetation.

Least bitterns may build small foraging platforms at the best feeding sites, enabling them to hunt over water 25-60 cm deep, as deep as is used by the largest herons (Gibbs et al. 1992). Small fish are the primary prey, though snakes, frogs, tadpoles, crayfish, insects (primarily *Odonata* and *Orthoptera)*, small mammals (shrews and mice), and vegetation may be eaten (Gibbs et al. 1992). Least bitterns nest in dense stands of emergent vegetation near or over open water (DeGraaf and Yamasaki 2001).

1.2 Justification

The least bittern is thought to have declined in many areas of the eastern United States and adjacent Canada (Gibbs et al. 1992). Palustrine freshwater and brackish emergent wetlands, where least bitterns make their homes, are among the most threatened habitats in the country (Gibbs et al. 1992). The least bittern is listed as endangered in Massachusetts (Massachusetts Natural Heritage Program 2003), threatened in Connecticut (Connecticut Department of Environmental Protection 2004) and is a species of special concern in Vermont and New Hampshire. Pollution, sedimentation and invasion by purple loosestrife (*Lythrum salicaria)* and phragmites (*Phragmites australis)* degrade cattail-dominated wetlands (Gibbs et al. 1992), especially in southern New Hampshire, where development pressures are highest. Although least bitterns seem tolerant of human presence and may persist in highly urbanized areas if wetlands remain relatively undisturbed, they may be subject to increased predation by generalist predators such as snapping turtle (*Chelydra serpentina)*, crow (*Corvus brachyrhynchos*), and raccoon (*Procyon lotor)* that are also tolerant of human activity (Gibbs et al. 1992).

1.3 Protection and Regulatory Status

Protection under the Federal Migratory Bird Treaty Act of 1918.

1.4 Population and Habitat Distribution

The least bittern is a rare and local breeder in New England. It is found primarily in eastern Massachusetts and Rhode Island, as well as Connecticut, Vermont and coastal Maine (DeGraaf and Yamasaki 2001). It has apparently always been rare in New Hampshire, where historical sightings were few and were concentrated in the southern part of the state. There are historical records from Concord, Hampton, Seabrook and the Connecticut River valley, of which some may have been migrants (Vernon 1994). There were no breeding records at the time of the compilation of the *Atlas of Breeding Birds in New Hampshire,* although it was thought that the species had likely nested here (Vernon 1994). Multiple individuals seen during the mid to late 1980s at Eel Pond in Rye and recently at Stubbs Pond in Newington (2002), and a lone juvenile observed at the Exeter sewage lagoons in early September 1994, suggest possible breeding at these locations.

Similarly, single occurrences of least bittern over several years during the mid 1980s at Cascade Marsh in Sutton indicate potential breeding habitat for the species. Towns with single records are Durham, Derry, Candia, and Newmarket. A 1997 least bittern record in a cattail wetland at Pondicherry Wildlife Refuge in Jefferson, Coos County, is the northernmost record in New Hampshire.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Habitat Map for Marsh and Shrub Wetlands.

1.7 Sources of Information

NatureServe (2005) was used for status and ranking information. New Hampshire Wildlife Sightings (2005) and NHNHB databases (2005) and Vernon (1994) were the primary sources of locality records. Habitat and life history information was taken from published literature, including the *Atlas of Breeding Birds in New Hampshire* (Foss 1994).

1.8 Extent and Quality of Data

In New Hampshire, the least bittern appears to be limited to a few suitable cattail marshes, mainly in the southern part of the state. Because its secretive nature makes it unlikely to be detected even in the most suitable habitat, the lack of sightings does not imply the absence of the least bittern (P. Hunt, NHA, personal communication). Among the few least bittern records, recent distribution data are largely the result of records submitted to the New Hampshire Wildlife Sightings web page from NHBR.

1.9 Distribution Research

Experienced birders should identify and report least bittern locations. Standardized census techniques, including the use of tape-recorded vocalizations to elicit responses from breeding birds, are needed to provide more information regarding distribution. The least bittern, American bittern, Virginia rail, sora, and other elusive wetland birds should be incorporated into comprehensive wetland bird monitoring efforts.

Element 3: Species Threat Assessment

The loss of wetlands likely poses the most significant threat to least bittern in the northeastern United States (Gibbs et al. 1992). See Threats in Marsh and Shrub Wetlands profile.

Element 4: Conservation Actions

See Marsh and Shrub Wetlands habitat profile for relevant conservation strategies. Tall grass-like emergent vegetation, especially cattail, should be maintained at the borders of ponds and wetlands. Management of federal and state impoundments to encourage dense, emergent vegetation, especially cattails, will create potential breeding habitat (Gibbs et al. 1992).

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5.2 Data Sources

New Hampshire Natural Heritage Bureau. 2005. Database of Rare Species and Exemplary Natural Community Occurrences in New Hampshire. Department of Resources and Economic Development, Division of Forests and Lands. Concord, New Hampshire, USA.

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SPECIES PROFILE

Least Tern

Sterna antillarum

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G4
State Rank: SHB
Author: Allison M. Briggaman, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Least terns use open beaches and vegetation-free islands for nesting. Although they may nest in areas with a substrate of larger stones, they prefer sand, shell, or gravel substrates high above the tide line. Like other terns, least terns tend to nest in colonies and are most productive at locations where colonies have been successful in previous years (Thompson et al. 1997). Unlike other terns, least terns tend to nest in areas attached to the mainland (Kress and Hall 2004).

1.2 Justification

Least terns, whose nesting colonies are sensitive to disturbance, are declining in number in some areas of their range (NatureServe 2005). In New Hampshire, the least tern is listed as endangered due to the absence of a breeding pair and the loss of nesting habitat due to anthropogenic factors.

Development along the Atlantic coast has resulted in significant habitat loss and degradation (United States Fish and Wildlife Service (USFWS) 1985), and New Hampshire Bird Records indicate that least terns have been rare and non-breeding in the state since 1980. The combined pressures of development and increased human recreation have in some areas caused least terns to abandon their natural habitats and nest on flat, gravel rooftops (Thompson et al. 1997, Kress and Hall 2004).

Although North American Breeding Bird Survey (BBS) data indicate a significant decline of least terns in North America between 1978 and 1988, populations were stable or increasing from the mid 1970s to the mid 1980s. This increase may have been the result of improved and expanded monitoring efforts during this period, especially along the Atlantic coast from Virginia to Maine (USFWS 1987).

1.3 Protection and Regulatory Status

New Hampshire RSA 212-A:6 IV(a) Endangered Species Conservation Act
Federal Migratory Bird Treaty Act of 1918
BCR 30 priority bird species (Highest concern)
PIF (physiographic area 28) priority bird species

1.4 Population and Habitat Distribution

Few records exist of least terns nesting in New Hampshire. Terns fed in Portsmouth in 1932 and the New Hampshire Audubon recorded 2 to 10 pairs nesting in Seabrook from 1953 to 1960. New Hampshire Bird Records indicate that least terns have been rare and non-breeding in the state since 1980. Although least terns are common in many parts of their range in North America, their preferred nesting habitat is also prime coastal real estate prone to development and human recreation (Thompson et al. 1997).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See coastal sand dune systems.

1.7 Sources of Information

Information on least tern habitat, population distribution and status was collected from literature, New Hampshire Fish and Game data, Tern Management Plans and Partners in Flight and the internet.

1.8 Extent and Quality of Data

Although least terns have been much studied throughout their breeding range, and although data regarding their biology and behavior is extensive, little is known about their demography and associations between wintering areas and breeding populations. Locally, the extent and quality of data on the distribution of the species is limited.

1.9 Distribution Research

Globally, more research is needed to understand the species' use of associated breeding and wintering areas, evaluate the success of management practices, identify the species' behavioral and demographic responses to humans and other animals (both domestic and wild), identify contaminant threats, and obtain better estimates of the species' demographics.

Locally, consistent survey and monitoring efforts would provide data on the current distribution and abundance of the species in the state. Along with more research, management of remaining habitat is necessary if least terns are to breed again along the New Hampshire coast.

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SPECIES PROFILE

Nelson's Sharp Tailed Sparrow

Ammodramus nelsoni

Federal Listing: Not listed
State Listing: Special Concern
Global Rank: G5
State Rank: S3B
Authors: Megan J. McElroy and Kimberly J. Babbitt, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

In New Hampshire, Nelson's sharp-tailed sparrows (hereafter, Nelson's sparrow) inhabit salt marshes, which are grass-dominated tidal wetlands existing in the transition zone between ocean and upland (Niering and Warren 1980) (see Salt Marshes habitat profile). They breed in marshes where smooth cordgrass, saltmeadow grass, and blackgrass are bordered by cattail, reed, and marsh elder (Greenlaw and Rising 1994). Sparrows forage on the ground in dense, wet grasses (e.g., cordgrass, blackgrass), areas of wrack, and edges of ditches, pools, and salt pannes (Greenlaw and Rising 1994). Their diet consists mainly of adult and larval insects, spiders, and amphipods. Grass seeds and herbaceous plants become an important part of their diet during fall migration (Greenlaw and Rising 1994).

1.2 Justification

Nelson's sharp-tailed sparrow has been designated a species of high conservation priority (Breeding Tier I) by Partners in Flight. In New Hampshire, Nelson's sparrow is a species of special concern. Few data exist on population trends, estimates, and threats in the state, and a long-term study of this species in New Hampshire has not been conducted. Ongoing and historical habitat loss and degradation are probably the most pressing threats to Nelson's sparrow populations in the Northeast. Protecting breeding habitat and Nelson's sparrow populations in New Hampshire is important to regional survival of this species.

High-quality salt marsh habitat available in large patches across a landscape is required for a population's persistence and growth. Degradation and loss of salt marsh habitat caused by tidal restrictions have resulted in the replacement of typical salt marsh vegetation with invasive reeds and grasses, such as cattails and common reed (Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998). Areas of invasive plants in and around salt marshes decrease available habitat for breeding Nelson's sparrows because they are not suitable habitat.

The current lack of knowledge regarding Nelson's sparrow populations in New Hampshire and threats to these populations is similar to that for other closely related salt marsh birds, such as salt marsh sharp-tailed sparrow and seaside sparrow. With further research and monitoring, this salt marsh guild may serve as an indicator of marsh health, the effects of marsh degradation, and the success of management practices.

1.3 Protection and Regulatory Status

- The Migratory Bird Treaty Act of 1918 legally protects Nelson's sparrows from the take, transport, and use of the species, including eggs, nests, and feathers.
- NHDES regulates human impacts on salt marshes. Any activity that may involve filling, dredging, or destroying wetlands is subject to strict guidelines and requires approved permits before work can commence (RSA-A).

1.4 Population and Habitat Distribution

Nelson's sparrow is a northern species that breeds in the Gulf of Maine and Nova Scotia west to Alberta

(Sibley 1996), and much of its breeding populations occur in the Northeast (Hodgman et al. 2002). New Hampshire is the southern periphery of the breeding range, yet they do breed in salt marshes in southeastern New Hampshire (Gavutis 1994, NHBR, McElroy and Babbitt, unpublished data). Any of these marshes can be used as migratory habitat for Nelson's sparrows; however, the largest breeding population occurs at sites around Great Bay (NHBR, McElroy and Babbitt, unpublished data).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

A literature review was conducted on Nelson's sparrows to obtain habitat, population distribution, and status data. NHA database of Bird Records was used for historical information on the distribution of Nelson's sparrows. Detailed information on current population distribution and status was obtained from data collected in 2004 by researchers from UNH.

1.8 Extent and Quality of Data

Historical bird records from NHA include sightings reported by birders. Although this information is vital to knowledge of historical distribution, it does not give an accurate account of population size or confirmed breeding locations throughout the state. In addition, the American Ornithologists' Union Committee in 1995 redefined the sharp-tailed sparrow (*Ammodramus caudacutus*) into two separate species: Nelson's sharp-tailed sparrow and saltmarsh sharp-tailed sparrow (*Ammodramus caudacutus*). Therefore, historical records prior to the split do not distinguish these 2 species. The most extensive dataset comes from UNH researchers. It includes confirmed breeding locations and population estimates throughout the state for the breeding season in 2004. Significant gaps exist in knowledge of breeding populations and long-term trends in abundance throughout the state.

1.9 Distribution Research

A long-term survey of salt marsh habitat (i.e., point counts conducted during breeding season at established points) is needed to determine the distribution of Nelson's sparrow in New Hampshire. It is essential that this effort be long-term because the quality of salt marsh habitat changes over time, potentially affecting Nelson's sparrow populations from one breeding season to the next.

Element 2: Species/Habitat Condition

2.1 Scale

The New Hampshire conservation unit for Nelson's sparrow is Great Bay and Portsmouth.

2.2 Relative Health of Populations

In New Hampshire, the abundance of the Nelson's sparrow population during the breeding season is estimated at approximately 50-75 individuals (McElroy and Babbitt, unpublished data). Because a sufficient long-term survey for Nelson's sparrows has not yet been implemented and Breeding Bird Survey routes do not sufficiently cover salt marshes, population trend data are not available. In 2004, a complete survey of all potential breeding salt marshes in New Hampshire was conducted for the presence and abundance of Nelson's sparrows.

Data collected during the 2004 breeding season showed sparrow activity in the following locations, categorized by breeding status (Confirmed Breeding = nests found and/or fledglings observed; Possible Breeding = adults present throughout season, singing activity, no evidence of nests and/or fledglings; Potential Breeding = a few birds present feeding at some point in the season, no evidence of any current breeding activity) (table 1). Estimated Relative Abundance (ERA) categories are also included.

2.3 Population Management Status

There are currently no ongoing population management efforts for Nelson's sparrows in New Hampshire (see Salt Marsh Habitat Profile, Element 2.3). All populations should be considered priorities for conservation.

2.4 Relative Quality of Habitat Patches

Currently in New Hampshire, Nelson's sparrows breed in *Spartina*-dominated salt marshes on Great Bay that are approximately 20-30 hectares in size (McElroy and Babbitt, unpublished data). Shriver et al. (2004) found that the occurrence of Nelson's sparrows in the Gulf of Maine was correlated with marsh size, proximity to other marshes, and road density surrounding the marsh. However, all New Hampshire salt marshes have the potential to fulfill key ecological functions (e.g., small marshes may not provide suitable nesting habitat, but may be important stopover sites). Research is needed to fully understand habitat quality with respect to Nelson's sparrow ecology.

2.5 Habitat Patch Protection Status

See Salt Marshes habitat profile (element 2.5)

2.6 Habitat Management Status

See Salt Marshes habitat profile (element 2.6)

2.7 Sources of Information

A literature review provided information on research and habitat management. Research conducted by UNH scientists was used to determine the current health of the population and population management status. The New Hampshire Coastal Program (NHCP) website was used to obtain habitat protection and management information and articles on habitat restoration.

2.8 Extent and Quality of Data

Currently, the most extensive dataset comes from researchers at the University of New Hampshire and includes confirmed breeding locations and population estimates throughout the state. However, this dataset is only from one field season. Therefore, a long-term study is needed for an adequate assessment of population health and habitat suitability. There are still significant gaps in knowledge and understanding of Nelson's sparrow populations and the effects of habitat restoration.

2.9 Condition Assessment Research

Long-term monitoring of these populations is essential to knowledge of population dynamics, trends, and ecology. Monitoring will provide valuable data to increase understanding of threats to Nelson's sparrow and effects of habitat management efforts.

To determine population abundance at sites of known use and therefore a more accurate assessment of marshes of high protection/conservation priority, a more in-depth monitoring of the breeding population—in addition to point count surveys—is needed. Because this species is non-territorial, point-count surveys and similar methods cannot accurately estimate population abundance. A long-term mark-recapture banding effort of the population would provide a more accurate estimate of sparrow abundance.

With a long-term dataset of presence/absence and abundance estimates at marshes throughout New Hampshire, a map could be produced targeting locations with high densities of breeding birds and hot spots for additional research, conservation, and habitat protection. This information is critical for any future conservation efforts and for research into habitat suitability for this species in New Hampshire.

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
See Salt Marsh Habitat Profile

(B) Evidence
Habitat loss is a significant factor in the localized extinctions and decline of wetland birds in northern New England, especially species such as the Nelson's sparrow that use salt marshes for nesting (Greenlaw and Rising 1994). Shriver et al. (2004) found that occurrence of Nelson's sparrows around the Gulf of Maine correlated positively with marsh size and the proximity to other marshes. Therefore, continued habitat loss due to land development likely will reduce Nelson's sparrow populations in New Hampshire.

3.1.2 Development (Fragmentation)

See Salt Marsh Habitat Profile

3.1.3 Altered Hydrology (Tidal Restriction), Transportation Infrastructure
See Salt Marsh Habitat Profile

3.1.4 Introduced Species (Introduced Plants)
See Saltmarsh Sharp-tailed Sparrow Profile

3.1.5 Altered Hydrology (Mosquito Ditching)
See Saltmarsh Sharp-tailed Sparrow Profile

3.1.6 Mercury
See Saltmarsh Sharp-tailed Sparrow Profile

3.2 Sources of Information

Information on threats to Nelson's sparrows was obtained from a literature review, NHCP, NHNHB, and Biodiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

Researchers and managers have recently given significant attention to threats to Nelson's sparrows. It is well documented that historical marsh degradation from human activities is correlated with decreases in sparrow populations. However, researchers studying the effects of mercury are attempting to evaluate the significance of this new threat to Nelson's sparrows and other salt marsh nesting birds, and continued research is warranted.

3.4 Threat Assessment Research

Scientists are assessing threats to Nelson's sparrow populations in Maine and New Hampshire (see references for published studies, McElroy and Babbitt, unpublished data). The impacts of invasive plant species and increased human disturbance surrounding marsh habitat (e.g., increased road density and noise) are two important areas for future research.

Of critical importance, more research is needed to determine the effects of methylmercury on Nelson's sparrow populations in New Hampshire. Methylmercury has become a regional ecological and human health concern. Although the Biodiversity Research Institute is investigating the effects of mercury on salt marsh birds in New England, research is needed especially in New Hampshire. Once mercury effects have been assessed through scientific research, conservation actions can be implemented to combat the problem.

Element 4: Conservation Actions

4.1.1 Protecting remaining salt marsh habitat and surrounding upland buffer habitat, Habitat Protection
See Saltmarsh Habitat Profile and Saltmarsh Sharp-tailed Sparrow Profile

4.1.2 Restoring degraded salt marshes back to Spartina-dominated systems, Restoration and Management
See Saltmarsh Habitat Profile and Saltmarsh Sharp-tailed Sparrow Profile

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Element 6: List of Figures

Table 1. New Hampshire salt marshes with Nelson's sharp-tailed sparrows during the 2004 breeding season (McElroy and Babbitt, unpublished data).

MARSH	TOWN	BREEDING	ERA
Chapman's Landing	Stratham	Confirmed	16 – 30
Squamscott River	Newfields	Confirmed	< 15
Sagamore Creek	Portsmouth	Possible	< 15
Hampton Beach	Hampton	Potential	< 15
Little River	Hampton	Potential	< 15
Bay Road	Newmarket	Potential	< 15

SPECIES PROFILE

Northern Harrier

Circus cyaneus

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S2B
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Northern harriers use a variety of open and semi-open habitat throughout the year, including grassland, cattail marsh, salt marsh, shrub-steppe, and agricultural land (MacWhirter and Bildstein 1996). In the Northeast, the species may nest in wetter habitat, although birds still forage extensively in upland areas (Serrentino 1992). The species also frequents bogs and fens with open foraging areas and a brushy border for nesting. Important features of nesting areas in northern New Hampshire include dense stands of low woody plants (*Spirea, Alnus, Cornus*, heaths) near open grassland areas for foraging (Serrentino 1992, 1998).

In northern Coos County, key habitats included hayfield, pasture, early successional field, late successional field, and shrub wetland (Serrentino 1998). Collectively, open and partially open upland habitats in this study comprised 59-75% of total habitat in each focal area. In west-central New Hampshire, historic sites in Danbury and Sutton are large wetlands bordered by shrubs and cattails.

Winter records of harriers in New Hampshire are almost entirely from the Seacoast (NHBR), where the species is found in salt marsh and associated upland brushy edges. There are also a few breeding records from salt marsh and nearby open areas.

Limited data suggest that harriers prefer larger fields. In Massachusetts, harriers only used fields over 11 ha (27.5 ac) (Serrentino 1992), whereas blueberry barrens in Maine needed to be at least 100 ha (250 ac) (Vickery et al. 1994). Wetlands used for foraging need not be as large, with areas as small as 1 ha (2.5 ac) being used in Maine (Gibbs et al. 1991).

1.2 Justification

Harriers were believed common in New Hampshire following extensive forest clearing in the 1800s. Beginning in the early 1900s, however, populations began to decline, probably a result of reforestation, wetland loss, persecution, and pesticide contamination (Foss 1994). By the 1970s, the species had become restricted to its current range and abundance in New Hampshire.

Harrier populations over the entire North American breeding range are declining at a rate of 1% per year (Sauer et al. 2004). In the East and Northeast, harriers are infrequently detected during the Breeding Bird Survey. According to detailed statewide accounts, the species has declined in New York (Andrle and Carroll 1988), Vermont (Laughlin and Kibbe 1985), Connecticut (Zeransky and Baptist 1990), and Massachusetts (Viet and Petersen 1993), and is of conservation concern in most northeastern states (Serrentino 1992). In 2001 and 2002, harriers nested in Essex County, Massachusetts for the first time in over 30 years (Berry 2003). These records, in conjunction with increased breeding season sightings in southern New Hampshire (NHBR), suggest the possibility of a partial recovery of coastal populations in the Gulf of Maine.

1.3 Protection and Regulatory Status

This species is protected at the federal level by the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs. In New Hampshire it is protected by the New Hampshire Endangered Species Conservation Act (RSA 212).

1.4 Population and Habitat Distribution

Scant data exist on the distribution of northern harriers in New Hampshire prior to the 1800s. Historically, the species was probably restricted to bogs, fens, and similar wetlands (e.g., beaver meadows), and perhaps isolated agricultural clearings along major river valleys. The species may have benefited from extensive forest clearing in the 1800s, and by the early 1900s it was nesting in small numbers over most of the state, with the possible exception of the southwest (Foss 1994).

By the 1960s, Coos County was the stronghold for New Hampshire's harrier population (NHBR). This distribution was largely unchanged during The Breeding Bird Atlas surveys in the early 1980s (figure 1a), documented roughly 16 territories in the state (Foss 1994, NHBR), not all of which were breeding territories. Over the next 15 years, there were between 19 and 21 territories, of which 8 to 13 were active breeding territories. Recent data are scarce because the annual "harrier day" surveys in northern Coos County were discontinued in 1997. Between 1998 and 2003, breeding season harriers were reported at 15 locations, and only 6 of these were in the species' traditional stronghold in the northern Connecticut River valley (NHBR).

Statewide, harrier distributions did not change appreciably from the 1980s to the 1990s (figure 1). The range included 3 areas: Coos County, the Connecticut River valley between Piermont and Lyman, and a complex of wetlands (Danbury Bog) in west-central New Hampshire. Except for Danbury Bog, no site supported harriers for more than 2 years between 1981 and 2003. Harriers bred at Danbury Bog 3 times between 1985 and 1991, and a single individual was observed in June 2001.

The Coos County portion of the range can be further divided into the upper Connecticut valley from Columbia north, the Androscoggin valley between Errol and Shelburne, and the Lancaster/Whitefield/Jefferson area. Harrier activity has been traditionally concentrated in the former, which contains 58% (11 of 19) of the regularly occupied territories in the county (and 50% of the entire state). All but one of the Connecticut Valley territories (91%) were occupied for at least 7 years between 1981 and 2000, while only 3 territories in the Androscoggin Valley or Lancaster/Whitefield/Jefferson area met this same criteria.

Harriers are rare during the breeding season away of the core areas discussed above (figure 1b). Since 1990, reports have come from Tamworth, Dover, Derry, and Brookline. In addition, from 1998 to 2001, single harriers were seen during August in the Hampton/Seabrook salt marshes. Because of the later dates of these sightings, the birds in question could be early southbound migrants or dispersers from the new breeding location in northeast Massachusetts (see section 1.2). However, the regularity of coastal sightings indicates the potential for current or future nesting in this portion of New Hampshire.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

Harrier habitat modeling is complicated by the fact that the species can use 2 very different habitats (grassland and emergent marsh). Given that extensive grasslands and wetland complexes have already been identified as part of this strategy, a first step would be to identify all large parcels of these habitats. Although data on habitat size needs are sparse, there is some indication that harriers are more likely to use a site if it is over 100 ha (Vickery et al. 1994). A model with such a cut-off, though it would overlook some suitable areas, would be guaranteed to recognize the better habitat. In addition, sites north of the White Mountains should have greater weight than those south of the mountains, based on historic and current use. The resulting model is perhaps simplistic, but no data on landscape features exist that would allow for finer resolution.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Habitat modeling was informed by the Gulf of Maine Program (Banner and Schaller 2001). Data on harrier distribution in New Hampshire were compiled from NHBR and observations collected during NHA's "harrier days" between 1983 and 1997.

1.8 Extent and Quality of Data

Because harriers have not been consistently surveyed in northern Coos County since 1997, data are lacking on the species' current distribution in this former stronghold. Harriers continue in the Androscoggin and Lancaster/Jefferson areas, which are visited more frequently.

1.9 Distribution Research

If harrier distribution is to be understood, regular surveys in the northern Connecticut Valley must be reestablished. Likewise, searches of historic locations south of the White Mountains would determine if any breeding pairs persist in these peripheral areas. Given the coarse nature of the habitat model described above, research into patch size, landscape configuration, and habitat juxtaposition would be valuable in future efforts to identify suitable habitat.

Element 2: Species Condition

2.1 Scale

As discussed in section 1.4, there are 5 appropriate planning units for harriers in New Hampshire:

1. Northern Connecticut River grasslands: This area includes the towns from Stratford north to Pittsburg.
2. Androscoggin Valley: This area includes marshes and agricultural lands from Lake Umbagog south to Shelburne, and extends west to the Upper Ammonoosuc valley in Stark.
3. Lancaster/Whitefield/Jefferson
4. Central Connecticut River valley: This area includes wetlands and agricultural lands from Lyman south to Haverhill and Benton.
5. West-central wetlands: This area includes sites from Enfield in the northwest to Danbury in the northeast, and south to Sutton and Newbury.

2.2 Relative Health of Populations

Of the 5 units outlined above, only the northern 3 have consistently supported harriers for the last 25 years (table 1). Sites in the central Connecticut River Valley appear to have been used primarily during the early 1980s (Breeding Bird Atlas), and recent records are scarce. There are also fewer sightings in the west-central wetlands. Collectively, data suggest that harriers have declined in areas peripheral to their core range in Coos County. Yet without recent data, it is difficult to evaluate the species' status in the north.

2.3 Population Management Status

Harrier populations are not managed in New Hampshire (but see section 2.6).

2.4 Relative Quality of Habitat Patches

Data are insufficient to evaluate the condition of harrier territories in New Hampshire. Anecdotal information suggests that agriculture continues to decline in the northern Connecticut River valley, which would imply that some harrier territories may be affected by habitat change through succession. Many areas that include harrier territories appear stable in the Androscoggin and Lancaster areas, and some are protected.

2.5 Habitat Patch Protection Status

In the northern and central Connecticut River valley, essentially no harrier habitat is currently protected. In the Androscoggin Valley, harrier territories at Lake Umbagog and Pontook Reservoir are protected, while potential areas (including foraging habitat) outside of Umbagog and Pontook are not. In the Lancaster area, habitat around the Whitefield Airport is protected in the Pondicherry Division of the Silvio Conte National Fish and Wildlife Refuge, but other grassland areas remain privately owned. To the south, most historic harrier areas (including Cascade Marsh and part of Danbury Bog) are protected as state wildlife management areas.

2.6 Habitat Management Status

Other than at the Whitefield Airport, habitat management is not occurring. The airport has a Memorandum of Agreement with NHFG that defines a Northern Harrier Management Area and requires the following:

- Brush removal only between 1 September and 30 March
- Consultation with NHFG prior to any brush removal
- No use of herbicides, insecticides, or rodenticides without prior approval
- If nesting habitat is modified because of airport activities, the equivalent amount of suitable habitat must be provided elsewhere on the property

2.7 Sources of Information

Data on habitat condition for northern harriers were compiled from the literature or through discussion with observers familiar with local conditions in New Hampshire.

2.8 Extent and Quality of Data

Because regular surveys of the state's primary harrier areas were discontinued in 1997, there is no information on the current condition of over half of the state's historic territories. More regular coverage in the Androscoggin and Lancaster areas suggests that the species' population has not changed in the central and southern portions of Coos County.

2.9 Condition Assessment Research:

A thorough assessment of northern harrier status in New Hampshire will require revisiting core habitat in northern Coos County and historic sites in west-central New Hampshire, including the central Connecticut Valley.

Element 5: References

5.1 Literature

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5.2 Data Sources

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Element 6: List of Figures

SPECIES PROFILE

Osprey
Pandion haliaetus

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S2B
Author: Christian Martin, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

The osprey has a cosmopolitan distribution, occurring nearly everywhere in the world except Polar Regions during various portions of their annual cycle (Poole et al. 2002). Most ospreys in North America are long-distance migrants, traveling up to 5,000 mi (8,000 km) to and from their wintering areas in the Caribbean, Central America, and South America (Henny and Van Velzen 1972, Environment Canada 2001). Satellite tracking studies (Martell et al. 2001) show that ospreys that breed on the east coast of the United States winter primarily in northern South America and sometimes in Cuba and in Florida. Ospreys breeding in Florida, California, and other southern U. S. locations are essentially non-migratory (Poole et al. 2002). Female ospreys from most North American breeding populations usually winter farther south than do their male counterparts, and individuals of both sexes display strong fidelity to wintering and breeding sites.

Osprey do not make their first northward spring migrations from the tropics until they are nearly 2 years old, and generally do not establish breeding territories until they are at least 3 years old (Poole et al. 2002). When attempting to establish a breeding territory, young ospreys often settle within 32 mi (50 km) of natal areas, which contributes to the species' slow rate of colonizing vacant territory.

When ospreys return to New Hampshire from the tropics, they usually arrive in coastal areas first. Dispersal inland often involves travel upstream on the Connecticut, Merrimack, Piscataqua, Saco, and Androscoggin rivers. Local breeding territories are reoccupied beginning in late March and early April; early arrival dates reported for New Hampshire nest sites include March 24 at Great Bay, March 26 in the lower Merrimack River valley, March 29 in the Lakes Region, and April 6 in Pittsburg (Evans 1994, Martin et al. 2004). From April to mid-May, many individuals pass through the state en route to breeding areas far north of the state's border with Canada. During this spring migratory interval, ospreys are seen on all of the state's major rivers and lakes, as well as on many smaller streams and minor ponds, where they are able to obtain prey to fuel their migration.

Ospreys breed from Newfoundland across to Alaska up to and even beyond the tree limit, and they occur in every province in Canada and across the entire U. S. In northern New England and the Canadian Maritimes, ospreys typically establish breeding territories near large lakes, major rivers, and coastal estuaries. For example, a habitat model developed for the Gulf of Maine watershed (USFWS 2000) found that 90% of 200 osprey nests examined in Maine were located within 0.6 miles of major rivers or lakes of greater than 100 acres in size. Another key breeding habitat is wetland ponds, where flooding by beavers produces dead snags for nesting and shallow waters for fishing. Shallow water is preferred because it offers better access to aquatic prey. Suitable breeding habitat (Poole et al. 2002) included the following:

- Areas with dependable fishing sources located within 2 to 3 miles (Poole 1989), but occasionally as far as 8 miles (Prevost 1979, Hagan and Walters 1990) from potential nesting sites,
- Standing trees or other structures located in wetlands,

- An ice-free period of no less than 20 weeks, long enough to permit egg-laying (3 weeks), incubation (5 weeks), raising young (8 weeks), and post-fledging foraging skill development (4 weeks).

Breeding ospreys generally defend their nest site only (typically a perimeter of 50 to 100 m), rather than a much larger feeding territory. Spacing between adjacent nesting pairs is highly variable and is dependant upon regional prey abundance and distribution and upon availability and type of nest substrate (Poole et al. 2002). For example, mean distance reported between neighboring nests for a tree-nesting population in New York State averaged 410 m, whereas a platform-nesting population in salt marshes in southeastern Massachusetts nests averaged only 140 m apart. A boreal forest population in New Brunswick averaged a much more diffuse one pair per 51 ha (Stocek and Pearce 1983).

1.2 Justification

Ospreys have been closely monitored in the United States ever since severe population declines were first documented both in North America and elsewhere between the 1950s and the 1970s (Henny and Ogden 1970, Poole et al. 2002). The number of pairs nesting in coastal areas of southern New England declined about 90% during this period, Chesapeake Bay area pairs declined by about 50%, and populations in the Great Lakes region also dropped significantly. Research demonstrated that population losses during that period resulted primarily from presence of high levels of DDT and other persistent organochlorine pesticides in the aquatic food web, which caused severe eggshell thinning and extremely poor hatching success (Spitzer et al. 1978, Wiemeyer et al. 1988).

Ospreys can serve as valuable bio-indicators of general environmental quality in aquatic systems because they rapidly accumulate chemical contaminants, such as the organochlorine pesticide DDT and its metabolite DDE, contained in fish. A dramatic osprey population decline, caused by DDT contamination, occurred across much of North America beginning in the 1940s and continued until 1970 (Ogden 1977). Osprey populations have rebounded strongly since the banning of the use of DDT, with the most dramatic increases occurring in traditional or historical nesting areas rather than in newly colonized areas (Houghton and Rymon 1997).

1.3 Protection and Regulatory Status

Ospreys are protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the possession or killing of most non-game birds and the collection of their eggs or nests. The species was first listed as threatened by the State of New Hampshire in 1979 (R.S.A. 212-A: 1 et seq.), and is still so classified. Other federal measures that indirectly provide protection include the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136) for new and existing pesticide registration and use, the National Forest Management Act (16 U.S.C. 1600), and the Federal Land Management and Policy Act (43 U.S.C. 1701). Ospreys are also protected from unregulated international trade by an agreement of the 1975 Convention on International Trade in Endangered Species of Wild Flora and Fauna.

1.4 Population and Habitat Distribution

Osprey populations across much of North America have rebounded strongly since the banning of the use of DDT. Estimates in the mid-1980s indicated that North America then supported about 18,000 to 20,000 pairs of breeding ospreys (about 57 to 84% of the world population) and that about two thirds of those bred in Canada and Alaska (Poole 1989). Recent population estimates suggest that about one third of the world's breeding ospreys nest in Canada (Environment Canada 2001). There were an estimated 8,000 breeding pairs in the contiguous U. S. in 1981, but 14,200 pairs in 1994 (Houghton and Rymon 1997), an estimate that increased further to 16,000 to 19,000 pairs by 2001 (Poole et al. 2002). Annual population growth rates ranging from 6 to 15% have generally been reported across North America over the past 30 years (Ewins 1997). Specifically, average annual rates of population increase in northern Michigan, Wisconsin, southern Ontario, and upper New York State have been 7%, 8%, 10-15%, and 10%, respectively (Environment Canada 2001).

A summary of the recent population status of breeding ospreys in states adjacent to New Hampshire is summarized in Table 1. In New Hampshire, ospreys have been reported as migrants for more than a century, though they were historically documented as common summer residents only in the Umbagog Lake area (Maynard 1871, Brewster 1925).

Aerial surveys of Coos County, New Hampshire, conducted by the USFWS in 1970 and 1971, located a total of 7 and 12 osprey nests, respectively, and the Umbagog area breeding population was believed to number only 3 or 4 pairs by 1977 (Smith 1979). There are relatively few historical references about ospreys breeding in other parts of the state (see Allen 1902, Dearborn 1898, Scott 1921), and there are no comprehensive estimates of statewide historical distribution or population size prior to fieldwork initiated by the New Hampshire Audubon (NHA) and New Hampshire Fish and Game (NHFG) beginning in 1980 (Smith and Ricardi 1983). Since 1980, these two organizations have partnered to conduct extensive annual field monitoring of the state's breeding osprey population (Martin et al. 2004).

Surprisingly, there is only one historical reference to nesting ospreys in New Hampshire's Great Bay area (Scott 1921). Early population declines in New Hampshire may have resulted in part from removal, by loggers, of large pines for nest sites, especially those located on river and lake shorelines and in wetlands. Logging-related population declines have been documented elsewhere in North America (Ewins 1997).

New Hampshire classified the osprey as state threatened in 1980 and soon began to conduct field monitoring and management of the breeding population. During the 1980s, nest sites were limited almost completely to the Androscoggin River watershed. The first nesting in New Hampshire's coastal watershed was documented near Great Bay in 1989, followed by first nesting in the Connecticut River watershed in 1993, and in the Merrimack River watershed in 1996. New Hampshire osprey productivity for the 25-year period from 1980 to 2004 is shown in Table 2. Known available, active, and successful osprey nests in New Hampshire from 1980 to 2002 are shown in figure 2. Osprey fledglings produced at successful nests in New Hampshire from 1980 to 2002 are shown in figure 3.

1.5 Distribution Map

1.6 Habitat Map

Several habitats were mapped that are relevant to ospreys, including marsh and shrub wetlands and known great-blue heron rookeries. This information, along with new and available (e.g., rivers, lakes) data, will be used to map potential osprey habitat.

1.7 Sources of Information

General natural history information and some sources of original research discussed in this document were obtained primarily from The Birds of North America, No. 683: Osprey (Poole et al. 2002). Unless otherwise noted, New Hampshire specific data have been acquired by field monitoring and management activities conducted by NHA from 1980 to 2004 under several cooperative and/or contractual agreements and grants received from NHFG, Public Service Company of New Hampshire, and other funding sources (Martin et al. 2004).

1.8 Extent and Quality of Data

Since 1980, the osprey has been one of the most intensively monitored and managed species in New Hampshire. Breeding site and productivity data are derived from field monitoring conducted for 25 years by NHA staff and trained volunteer observers who use standardized monitoring techniques (Martin et al. 2004).

1.9 Distribution Research

The future distribution and abundance of ospreys in New Hampshire should be monitored by spring breeding surveys of recently active and potential breeding sites. Active breeding territories should be checked annually to determine nest occupancy status and reproductive outcome, and surveys of potential breeding territories should be conducted on a rotating basis, with annual survey intensity determined by available funding and human resources. For example, sites could be checked on a biennial or triennial rotating basis, covering 50% or 33% of potential sites annually.

Element 2: Species/Habitat Condition

2.1 Scale

New Hampshire's 5 major watersheds (Androscoggin, Coastal, Connecticut, Merrimack, and Saco watersheds) will be considered as separate conservation planning units because there are significant differences between watersheds in the physical characteristics, human land use patterns, population distribution, and nest sites utilized by ospreys (see figure 1).

2.2 Relative Health of Populations

2.1.1 Androscoggin River watershed

The Androscoggin River watershed is one of the most pristine and undeveloped major drainages in the state. Umbagog Lake at the Androscoggin's headwaters was the only part of the state that maintained breeding pairs of osprey through the region-wide period of decline in the 1950s through 1970s. The Umbagog Lake population may have been the source for the recolonization of much of the Androscoggin River watershed during early stages of population recovery in the 1980s and early 1990s. Presently, osprey pairs are clustered around two major water bodies, Umbagog Lake and Pontook Reservoir.

During the 2004 breeding season, the Androscoggin River watershed had the highest number of active nests of any major watershed; 14 young fledged from 12 active nests. The 14 young fledged represent 26% of the statewide number of young produced in 2004. Recently, there has been a shift in the distribution of the breeding population, with fewer pairs breeding near Umbagog Lake and more pairs breeding near Pontook Reservoir. The reasons for this shift are unclear, but may be influenced by changing availability of nest trees, forage base, interactions with aerial predators such as bald eagles, or other factors.

The population in this area should remain stable or continue to expand as long as nest tree availability remains high and the forage base remains in good condition. This area is characterized by spruce and fir forests and has high aquatic productivity. Many of the streams and lakes have good fish producing characteristics, such as high oxygen content and suitable substrate. Most of the lakes and streams are stocked annually and there are a high percentage of water bodies that contain warm water species. Land conservation initiatives, such as the establishment and expansion of the Lake Umbagog National Wildlife Refuge, and protection of shoreline by the State of New Hampshire, should protect foraging and nesting habitat in the long-term.

2.2.2 Coastal Watershed

The Coastal watershed in southeastern New Hampshire includes Great Bay and its tributary rivers and streams. Also included within this watershed are extensive coastal salt marshes along the state's immediate coastline and many isolated beaver ponds and wetlands in the headwaters of many of the river drainages mentioned above.

This area has been highly productive for ospreys since breeding pairs began to recolonize the area in 1989. Since the 2000 breeding season, more than 90% of all active nests located in this watershed have been successful. During the 2004 breeding season, this watershed had the highest number of successful nests of any major watershed; 14 young fledged from 9 active nests, 8 of which were successful. The 14 young fledged represent 26% of the statewide total number of young produced in 2004. Ospreys show an affinity for nests within great blue heron rookeries in this watershed. Nesting platforms erected in the coastal watershed have also been successful.

There is high potential for further breeding population expansion in the Coastal watershed due to the numerous lakes and ponds, an abundance of heron rookeries, and a focused effort to install additional platforms and replica nests. Currently there are 4 unoccupied platforms and 1 unoccupied replica nest in the coastal watershed.

2.2.3 Connecticut River Watershed

The Connecticut River watershed extends from the northernmost tip of New Hampshire to the state's southern border with Massachusetts. The Connecticut River flows through several ecoregions and includes several diverse habitats. Northern New Hampshire, characterized by soft and hardwood forests, has a long history of industrial ownership and uses. Agricultural uses are common within the drainage, especially in northern and central sections.

The osprey population in the Connecticut River watershed is in the early stages of recovery. During the 2004 nesting season, 8 young fledged from 5 active nests. The 8 young fledged represent 15% of the statewide total number of young produced in 2004. No active nesting attempts have been documented in the southern two thirds of this watershed, though there are 6 unoccupied platforms available along the southern two thirds of the Connecticut River in New Hampshire.

Foraging areas are plentiful in the northern Connecticut River watershed. The area is a popular destination for fishermen, and NHFG heavily stocks local water bodies with trout. The area also has a high number of low-lying shallow ponds oxbows and streams ideal for osprey hunting. The Connecticut River watershed contains some of the more rural areas left in New Hampshire. Recently, industrial landowners have sold large parcels of land in the northern region, including lands comprising the headwaters of the Connecticut River. As a result, a large portion of the watershed will be conservation land. Incentives are also being provided to farm owners throughout the watershed in an attempt to conserve some of New Hampshire's open field habitats and farms.

Nest site availability is potentially a limiting factor for osprey population expansion in the Connecticut River watershed. In northern areas, supercanopy pines are uncommon due in part to historical logging practices and due to elevation and predominating soil characteristics. The practice of retaining snags during timber harvests is a relatively new management consideration; snag retention became common only within the past 20 years. Therefore, the lack of larger diameter snags in the Pittsburg area may be a result of harvesting that occurred prior to their identification as desired wildlife retention species. Furthermore, soils in the northern extent of the state are not especially suited for white pine production, and spruce and fir characterize much of this area. Agricultural areas found within the northern, central, and southern sections of the Connecticut Watershed contain very few large diameter trees and are managed as fields.

2.2.4 Merrimack River Watershed

The Merrimack River watershed, including the Lakes Region, the upper Merrimack valley, and the lower Merrimack valley, drains an extensive portion of central and southern New Hampshire. Starting at Franconia Notch, the drainage continues south to the Massachusetts border. Water bodies within this area range from deep, cold lakes and ponds to shallow marshes. The Merrimack River is large, includes many oxbow ponds, and provides a substantial amount of potential osprey foraging and nesting habitat.

During the 2004 breeding season, this watershed had the highest number of young fledged; 17 young fledged from 8 active nests. The 17 young fledged represent 32% of the statewide total number of young produced in 2004. A majority of these active nests was located within heron rookeries, which are commonly found in beaver ponds throughout the watershed. There is high potential for ospreys to establish new nesting sites in heron rookeries scattered throughout the watershed, especially within the Lakes Region.

2.2.5 Saco River Watershed

The Saco River watershed located in the east-central portion of New Hampshire is mountainous. Water bodies within this area are typically clear, cold, and deep. Each of these characteristics is less than ideal foraging habitat for ospreys. Warmer, shallow water bodies tend to produce more foraging opportunities for ospreys. However, the sandy soils of the region are also characterized by an abundance of white pine, which are preferred by osprey as nesting trees. Through the 2004 breeding season, there were no known osprey nests located within this watershed.

The Saco River watershed has an abundant growth of supercanopy pine, yet the lack of white pine snags may be a limiting factor. Shallow water bodies and areas historically selected by great blue herons may offer potential osprey nest areas. Deep, oligotrophic lakes in the watershed have limited productivity due to the high abundance of granite and sand and, as a result, these water bodies are deficient in the correct characteristics to produce preferred forage species such as perch and pickerel.

2.3 Population Management Status

Management strategies for ospreys in New Hampshire fall into 3 categories:

1) Locate territorial pairs

From 1980 to 2004, NHA staff biologists solicited and evaluated public reports of ospreys in areas of potential breeding habitat and followed up with field surveys by staff or trained volunteer observers to identify occupied territories. The number of occupied nest sites has risen from 6 in 1980 to a recent high of 44 in 2003, and from presence in only 1 major watershed in 1988 to 4 of the state's 5 major watersheds by

1996 (Martin et al. 2004).

2) Monitor and manage nesting attempts
Nesting attempts have been monitored by trained volunteers observers and NHA staff biologists from 1980 to 2004, resulting in the documentation of 472 active nesting attempts, 296 successful nesting attempts, 613 young fledged (1.30 young/nesting attempt), and 176 nest failures (37% failure rate). The NHA staff installed sheet metal predator guards around the bases of nest trees to deter tree-climbing mammalian nest predators.

3) Augment natural nest sites by installing nesting platforms and replica nests
The NHA and NHFG began installing nest structures in 1977 around Umbagog Lake, but such activity did not begin in earnest until 1994 in the coastal watershed, when cooperation with Public Service Company of New Hampshire began. The primary objectives were to hasten colonization by ospreys of unoccupied areas of the state and to provide additional nesting opportunities for new osprey pairs within already occupied areas. As of the end of 2004, there were a total of 28 human-built structures (22 platforms and 6 replica nests) in place in New Hampshire for ospreys.

4) Public outreach and education
Information on the goals and status of osprey conservation efforts in New Hampshire has been disseminated in a variety of ways and has involved many different audiences. Extensive efforts have been made to educate the public on accurate identification and reporting of osprey. Articles and media news releases on the state's osprey recovery efforts and opportunities for direct public volunteer involvement appear annually in newspapers, on radio, and in newsletters of various natural resource agencies and conservation groups. The NHA staff offers public lectures and conduct volunteer training sessions annually to effective public participation in osprey conservation. Outreach to landowners, developers, and recreationists concerning osprey habitat needs are ongoing and essential.

2.4 Relative Quality of Habitat Patches

Currently occupied breeding habitat appears to provide the key ecological attributes required to support a healthy, expanding breeding population. Ospreys are generalist feeders that catch fish that linger near the water's surface (Poole et al 2002). The state's lakes and ponds, reservoirs, and rivers are well stocked and will likely provide foraging resources to support additional breeding pairs over the coming decade. The state's beaver and great blue heron population are at healthy levels; thus, the future development of new nest site habitat appears secure. Suitable nesting substrate does not appear to be a limiting factor, except perhaps in the Connecticut Lakes area where there are very few supercanopy pines available. The greatest ongoing habitat quality concerns include the following:

- Additional shoreline development near wetlands and on rivers and lakes, especially in the Merrimack River and the Coastal watersheds
- Increasing use of motorized watercraft and growing popularity of kayaks and canoes, especially in the Androscoggin River watershed
- Additional wetland losses, especially in the Merrimack River and the Coastal watersheds

2.5 Habitat Patch Protection Status

Of the 73 known osprey nests and human-built nest sites in 2004, 33 (45%) were located on public lands (16 federal, 12 state, 5 county or municipal government) and 40 (55%) were located on private land. Conservation easements or other formal conservation measures applied to 40 (55%) of the state's nest sites.

2.6 Habitat Management Status

Nest sites on public land are generally managed to promote productive breeding attempts, but few actual zone closures are in effect. Nest sites on private land are subject to landowner decisions, but outreach and education with landowners have usually resulted in land use practices that benefit osprey nesting success. No formal management agreements are currently in effect in the state.

2.7 Sources of Information

Information on the state's breeding osprey population is derived directly from summary reports and field data on monitoring and management activities conducted by ANSH from 1980 to 2004 under annual contracts and grants received from the NHFG, from Public Service Company of New Hampshire and other funding sources (Martin et al. 2004).

2.8 Extent and Quality of Data

Because ospreys have been state-listed as threatened since the late 1970s, few New Hampshire wildlife species have a more complete data set on occurrence, productivity, and nest site condition. Annual summaries of this information are on file at NHA.

2.9 Condition Assessment Research

Long-term baseline monitoring of breeding ospreys in New Hampshire remains an important task in order to detect future threats to a stable or growing population in the state. Formal adoption of the existing draft recovery plan, including specific targets for delisting, should be a priority. Additional research to determine contaminant loads present in New Hampshire osprey chicks should be encouraged and facilitated by NHFG in order to determine the potential impact on statewide productivity and population recovery.

Element 3: Species and Habitat Threat Assessment

3.1.1 Mercury and Non-point Source Pollution

(A) Exposure Pathway
There are many types of anthropogenic pollutants whose toxic residues are known to biomagnify, particularly in aquatic systems, as they reach species that occupy higher trophic levels, such as ospreys. While only infrequently resulting in direct mortality, these pollutants have a range of more common sub-lethal effects, especially in long-lived predators such as ospreys that accumulate toxins over a long period. These various neurotoxins produce reproductive, behavioral, neurological, and physiological changes that can result in reduced vigor and breeding success (Wiemeyer et al. 1988, Steidl et al. 1991, Evers 2005).

Ospreys continue to be exposed to toxic contaminants through the fish they eat. Although industrial discharge to surface waters has been significantly curtailed, toxic chemicals are transported long distances by air currents, and these chemicals enter aquatic systems via atmospheric deposition. Although the use of PCBs and dioxins has received much attention in North America, mercury has become an increasing problem in aquatic systems. One recent study conducted in Ontario and New Jersey found that mercury levels did not reach a level associated with toxic effects (Hughes et al. 1997), though another determined that high levels of mercury are present in adult and nestling ospreys in northern Quebec (Desgranges et al. 1998). Additionally, new pesticides continue to be developed that may have undetermined impacts on osprey and other wildlife.

(B) Evidence
Mercury levels are high and pervasive in northeastern North America in aquatic food webs (Hughes et al. 1997, Desgranges et al. 1998, Evers 2005). Brominated fire retardants, commonly known as PBDEs, are similar in chemical structure to PCBs, and are used in a wide range of synthetic household and consumer products. PBDEs have recently been shown to be accumulating in wildlife populations worldwide, including in raptors (Sharp and Lunder 2004). PCBs and many other organic compounds are also commonly detected in ospreys (Wiemeyer et al. 1998).

3.1.2 Recreation (Lead shot and sinkers)

(A) Exposure Pathway:
In a manner similar to what has been well documented in bald eagles, ospreys may be subject to lead poisoning by consuming lead sinkers associated within living or dead fish that they consume. This could potentially be an important source of anthropogenic morbidity and mortality. Continued use of lead fishing tackle (in violation of state laws) could threaten ospreys in certain areas.

(B) Evidence:
Lead poisoning of bald eagles has been documented in at least 34 states (Buehler 2000). Similar exposure in ospreys is far less well documented, however ospreys utilize a similar prey base of living and dead fish, and therefore would be expected to experience similar exposure. One difference is that ospreys are likely not exposed to lead shot because they do not typically feed on non-piscivorous prey and carrion (Poole et al. 2002).

3.1.3 Recreation (Boats and Jet Skis)

(A) Exposure Pathway
Recreational boating can modify osprey foraging patterns by reducing use of perching and foraging areas, potentially altering food delivery and productivity.

(B) Evidence
Motorized boat traffic on New Hampshire water bodies is increasing, as are the size of vessels and their top speed. Improved access to public waters has the potential to further increase the number of boats on the water. The growing popularity of small personal watercraft (motorized jet skis as well as self-propelled canoes and kayaks) has the added effect of bringing increased human traffic volume into the shallow coves and other areas where ospreys feed, perch, and rest.

3.1.4 Development (Shoreline Development)

(A) Exposure Pathway
Shoreline development and increased recreational on water bodies may disturb nesting adults and reduce availability of perching and feeding sites. Development can limit the future expansion of a recovering population and act to reduce future carrying capacity. New Hampshire is among the fastest growing states in the northeastern U.S. Shoreline real estate development contributes to secondary problems such as increased pollution and water-based recreation, which also have the potential to negatively impact ospreys.

(B) Evidence
Some osprey pairs have been documented to acclimate to frequent human activity at nesting sites, especially where the presence of human activity precedes nest establishment (Ewins 1996, Poole et al. 2002). However, many New Hampshire pairs do not appear to exhibited this high degree of tolerance. Shoreline development affects perching and foraging by ospreys, with possible direct and indirect effects on reproductive success. In Ontario, shoreline development has been suggested as a leading source of reduction in nest site availability (Ewins 1997).

3.1.5 Energy and Communication Infrastructure

(A) Exposure Pathway
Ospreys are attracted to high-tension electricity transmission towers and to smaller wooden utility poles as potential nest sites, and this exposes ospreys to the risk of electrocution (Ewins 1995). Although this is not considered the most significant risk to the state's osprey population, it can be managed through monitoring and collaboration with utility companies.

(B) Evidence
During the past decade, the number of power line osprey nests in New Hampshire has increased from 1 to 7 sites. Although there are no documented instances of electrocution of ospreys in the state, there have been cases where power interruptions have been caused by nest structures.

3.1.6 Development (Habitat Loss and Conversion

(A) Exposure Pathway
Availability of suitable nest sites appears frequently to limit some local breeding populations of osprey (Ewins 1997). Supercanopy pines near wetland edges and dead standing trees located in flooded beaver ponds are both highly attractive to ospreys as nesting sites. Flooded areas reduce the vulnerability of osprey nests to mammalian predators (Poole et al. 2002), and draining or filling of wetlands reduces the ability of these areas to support viable osprey nests.

(B) Evidence
Researchers working in certain parts of Europe have reported that some forestry practices have severely reduced or eliminated suitable supercanopy nesting trees, which resulted in fewer available nest sites for ospreys (Meyburg et al. 1996). In Ontario, timber extraction has been suggested as a leading cause of reduction in nest site availability (Ewins 1997).

3.1.7 Non-point Source Pollution (Pesticides and Herbicides)

(A) Exposure Pathway
Ospreys are exposed to DDT and other organochlorines in the fish they consume. These chemicals may be transported long distances by air and may enter aquatic systems via atmospheric deposition and precipitation. Although the use of DDT and other organochlorines has been much reduced in North America, ospreys may still be exposed on the wintering grounds and in migration.

(B) Evidence
The use of DDT has been greatly reduced in North America, but ospreys are long-distance migrants and are exposed to DDT and other organochlorine compounds in prey species on the wintering grounds and in migration (Elliott et al. 2000).

3.2 Sources of Information

Information on various threats to ospreys was obtained from literature review, from NHA field data, and from consultation with specialists employed by the USFWS, NHFG, and the NHA, all located in Concord, New Hampshire, and from BioDiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

Most of the threats described above have been examined carefully by researchers working outside of New Hampshire. The negative effects of mercury, PBDEs, PCBs, and DDT on aquatic species are well known and are well documented by researchers nationwide. There are sufficient data on the threat posed by lead to piscivorous bird species in New Hampshire that legislation has recently been passed that prohibits the use of certain size lead sinkers and jigs. There is no substantial New Hampshire specific data set on effects on ospreys of motorized and self-propelled boating activity. There is sufficient concern about shoreline and wetland habitat loss to justify strengthening land use policies and investing in more land protection efforts by federal and state agencies, and by non-profit conservation groups. Electrocution issues are currently being addressed in collaboration with local utility companies.

3.4 Threat Assessment Research

There are several areas where additional threat assessment research is warranted, including:

- Investigation into the likely future extent of wetland and shoreline development on water bodies in New Hampshire, and development of a pro-active plan that would better protect wildlife values associated with shorelines and wetlands.
- Investigation of the tolerance of osprey for recreational boating activity in the vicinity of nest sites and foraging areas
- Additional investigation of current levels of mercury, PCBEs, DDE, and other bioaccumulative pollutants in New Hampshire ospreys.

Element 4: Conservation Actions

4.1.1 Document breeding status, Restoration and Management

To determine occupancy status and reproductive outcome, distribution and abundance of breeding ospreys should be documented by nest site visits. Data on annual osprey productivity are needed to determine when recovery goals are achieved. This can be accomplished largely by training and coordinating a statewide network of volunteer nest site monitors. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.2 Finalize and adopt state recovery plan for ospreys, Regulation and Policy

Formally adopt an existing draft state recovery plan for ospreys (Martin et al. 2004) that includes specific targets for delisting. This conservation action builds on 25 years of ongoing management activities to insure population viability and establish clear targets for population recovery. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.3 Determine contaminant loads, Restoration and Management

Conduct more extensive monitoring of contaminant loads present in New Hampshire osprey chicks to determine the potential impact of toxics on statewide productivity and population recovery. This conservation action builds on 25 years of ongoing management activities to insure population viability and understand the effects of environmental contaminants. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, DDT, and organochlorines.

4.1.4 Nest site management, Restoration and Management

Install predator guards on nest sites and selectively place additional nesting platforms to disperse the breeding population. To minimize predation by mammalian predators such as raccoons and to increase productivity rates, the NHA and NHFG have installed predator guards on all new nest poles since 1994 and have installed predator guards on a majority of existing natural nest trees since 1985. Consult with local landowners and collaborate with utility companies to install additional nest poles and platforms to encourage colonization by ospreys of unoccupied areas of the state and to provide additional nesting opportunities for new osprey pairs in already occupied parts of the state. Direct threats addressed under this conservation action include motorized and self-propelled watercraft, shoreline development, electrocution, and wetland loss.

4.1.5 Encourage cooperative research, Restoration and Management

There is a need for more information on the effects of certain contaminants, osprey migration, and nest site fidelity. Migration should be studied using satellite tracking of a subset of the New Hampshire population. Current and proposed blood sampling will provide information on environmental contamination of New Hampshire osprey. Banding studies should also be conducted to assess nest site fidelity. In total, this research will improve our understanding of risk factors and will guide future conservation efforts. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, DDT, and organochlorines.

4.1.6 Provide public outreach materials, Education and Outreach

Enhance educational efforts about osprey biology, habitat, and land conservation issues to promote better local stewardship, reduce nest disturbance, and provide public support for wildlife protection efforts in general. Direct threats addressed under this conservation action include mercury, PBDEs, PCBs, lead, motorized and self-propelled watercraft, shoreline development, electrocution, wetland loss, DDT, and organochlorines.

4.1.7 Promote conservation of great blue heron colonies and healthy beaver populations, Restoration and Management

Particularly in the southern part of New Hampshire, ospreys commonly select great blue heron rookeries located in flooded wetlands as nest sites. To maintain and encourage a self-sustaining population of osprey, heron rookeries, and the beaver populations that produce dead standing trees in wetlands, should be maintained and protected from disturbance. Direct threats addressed under this conservation action include shoreline development and wetland loss.

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5.2 Data Sources:

Osprey nest and productivity surveys from 1981-2004, MS Access database, New Hampshire Audubon, Concord, NH.

Element 6: List of Figures

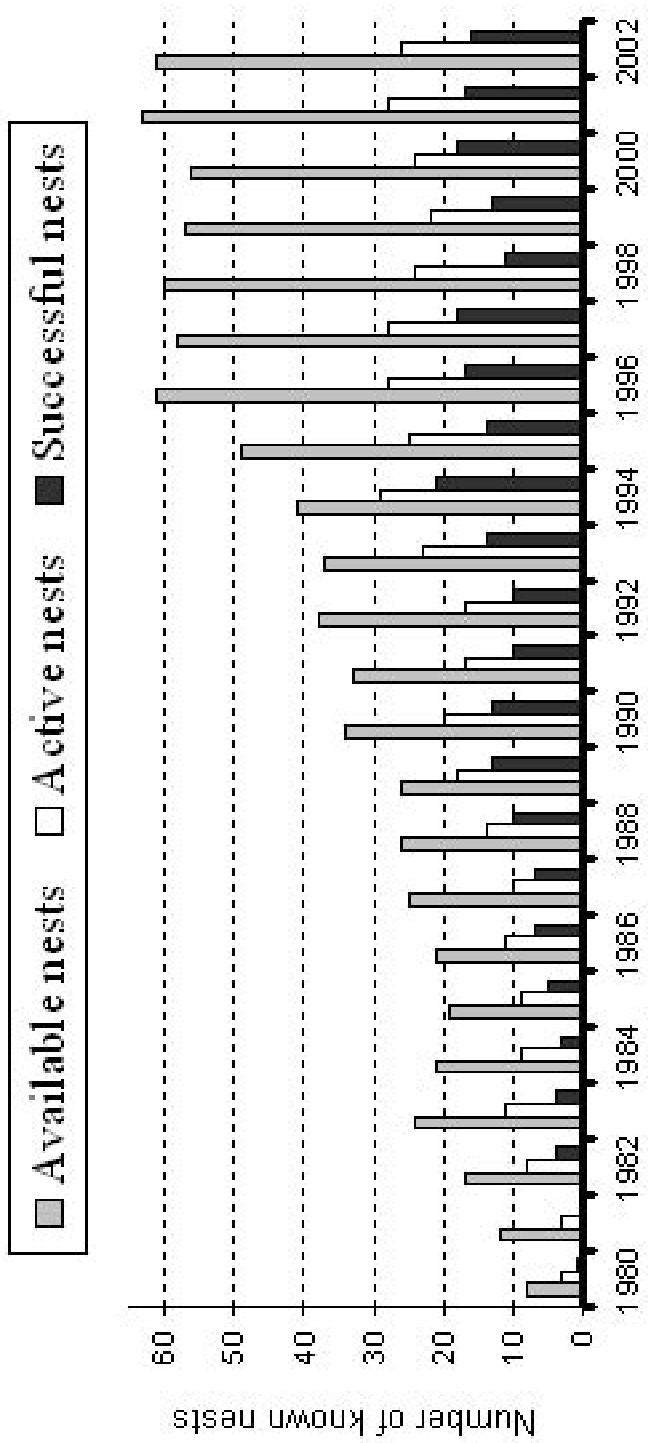

Figure 1. Number of known available, active, and successful osprey nests in New Hampshire from 1980-2002.

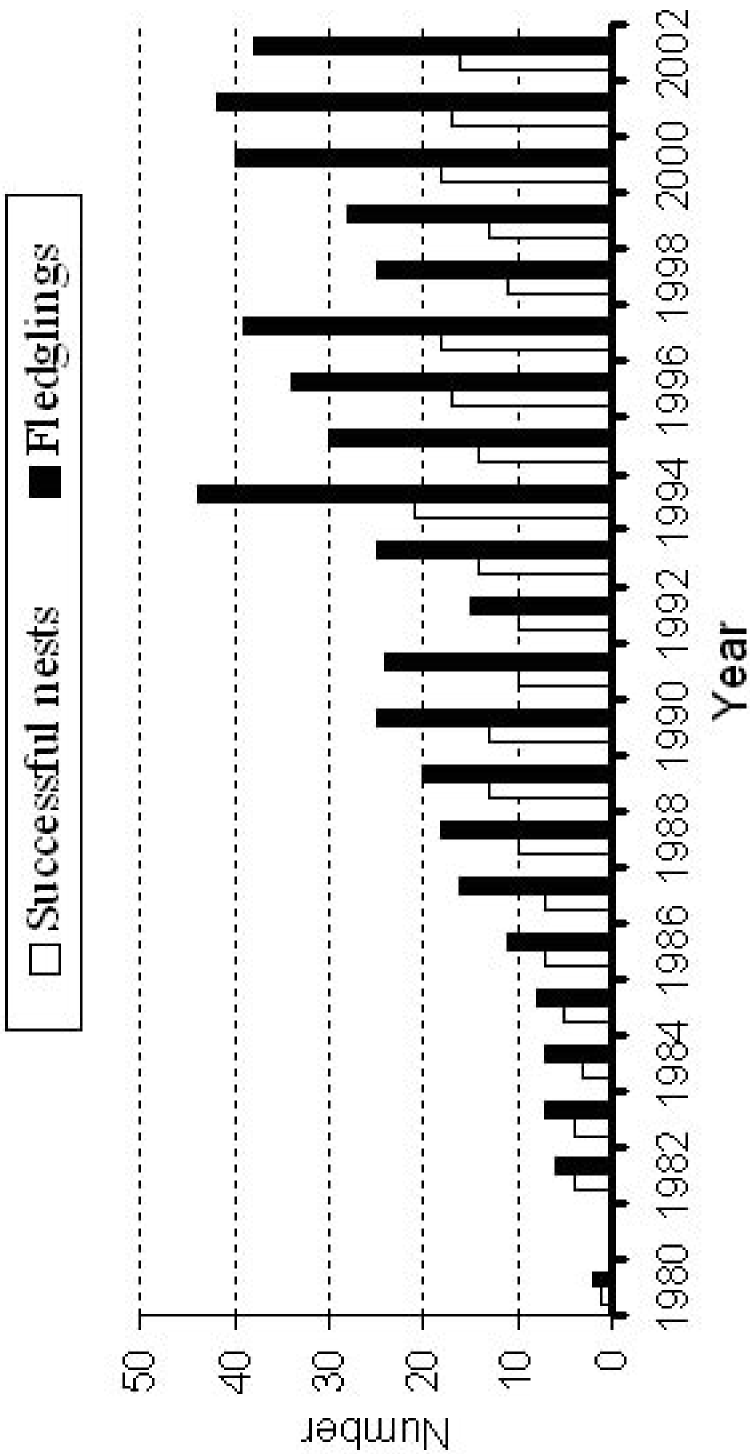

Figure 2. Number of osprey fledglings produced at successful nests in New Hampshire from 1980 to 2002.

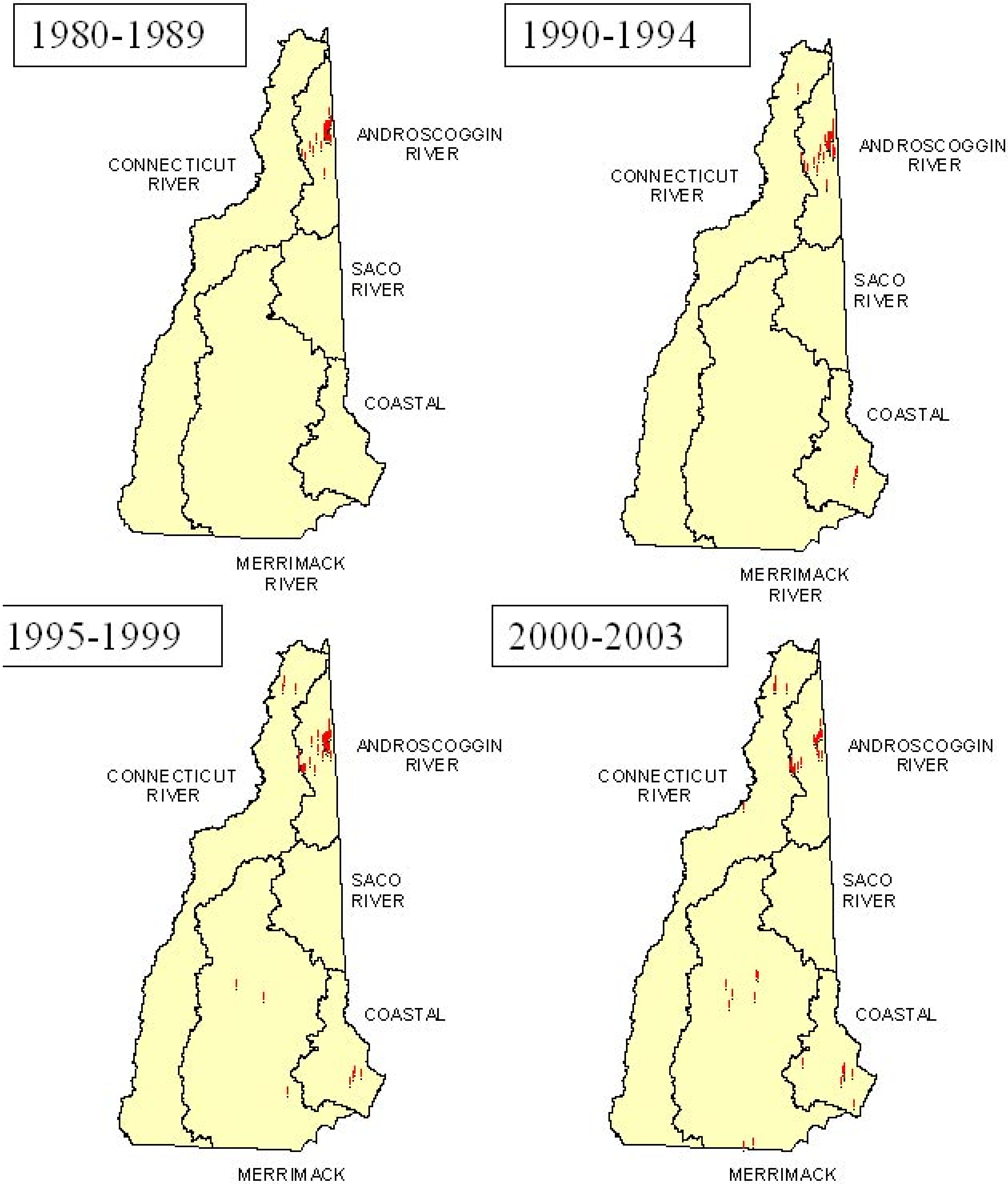

Figure 3. Distribution of known active osprey nests within five major watersheds in New Hampshire during 1980-1989, 1990-1994, 1995-1999, and 2000-2003.

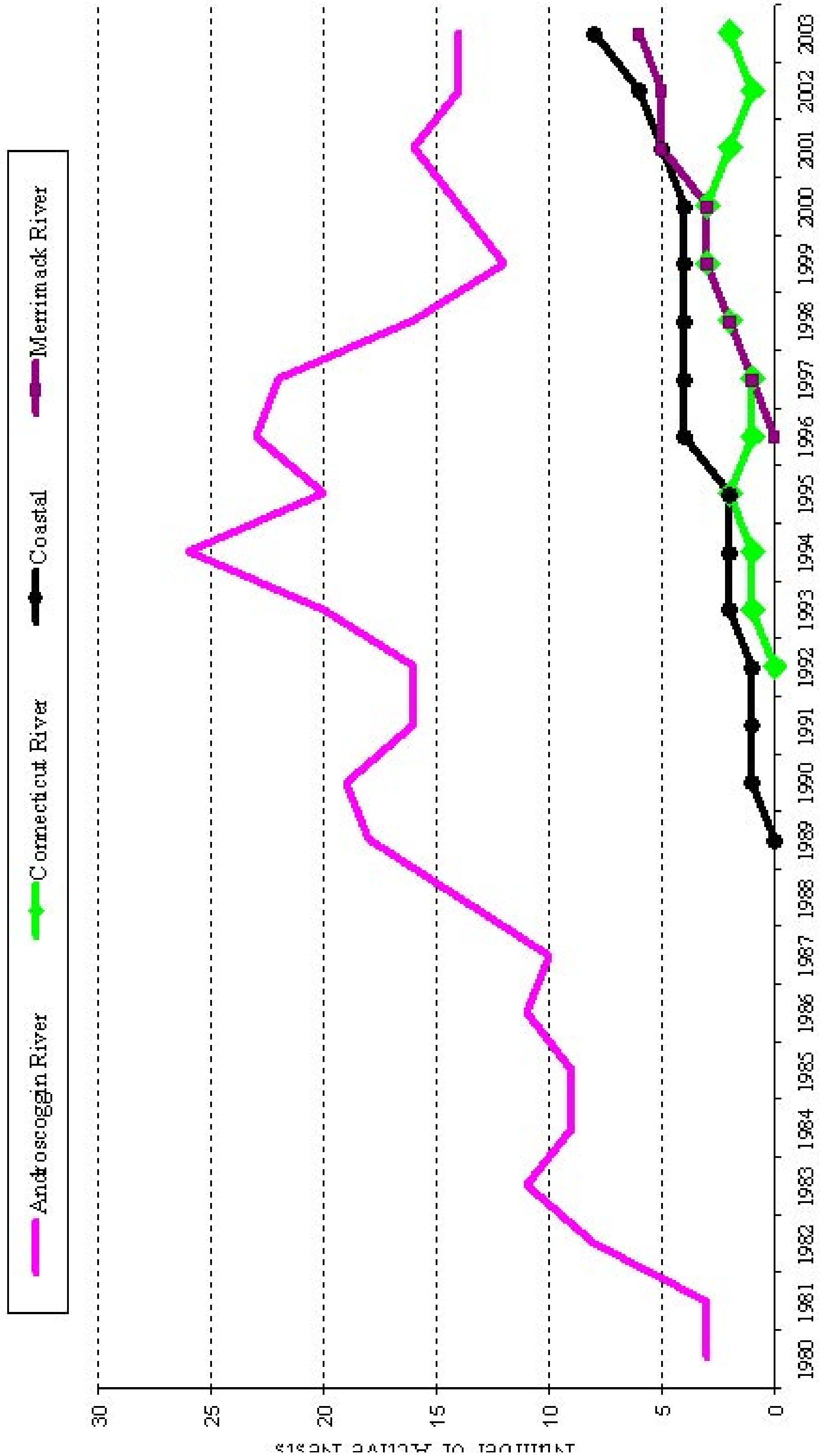

Figure 4. Number of known active osprey nests within four major watersheds of New Hampshire from 1980-2003.

Year	Occupied Nests	Active Nests	Successful Fledged	Young	Young per Nesting Pair
1980	6	3	1	2	0.67
1981	9	3	0	0	0
1982	14	8	4	6	0.75
1983	20	11	4	7	0.64
1984	15	9	3	7	0.77
1985	14	9	5	8	0.89
1986	15	11	7	11	1
1987	18	10	7	16	1.6
1988	21	14	10	18	1.29
1989	23	18	13	20	1.11
1990	26	20	13	25	1.25
1991	21	17	10	24	1.49
1992	33	17	10	15	0.88
1993	37	23	14	25	1.09
1994	32	29	21	44	1.52
1995	33	25	14	30	1.2
1996	43	28	17	34	1.21
1997	39	28	18	39	1.39
1998	36	24	11	25	1.04
1999	34	22	13	28	1.27
2000	39	24	18	40	1.67
2001	39	28	17	42	1.5
2002	32	27	17	40	1.48
2003	44**	30	23	54**	1.80**
2004	43	34**	26**	53	1.56
Totals for 1980-2004	**472**	**296**	**613**		**1.3**

Table 1. New Hampshire osprey productivity summary: 1980-2004.

SPECIES PROFILE

Palm Warbler

Dendroica palmarum

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3B
Author: Kim A. Tuttle, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Palm warblers nest in bogs and fens in boreal forests, usually on the ground beneath a short conifer (Richards 1994, Wilson 1996). Shrub openings, sphagnum, and a spruce or tamarack canopy are key habitat characteristics (Welsh in Richards 1994).

1.2 Justification

The palm warbler reaches the southern extent of its nesting range in northern New Hampshire, which may explain its absence from several apparently suitable nesting habitats. Peatlands are rarely altered and palm warblers are less likely to be affected by habitat fragmentation than are forest dwelling birds in the northeastern and central United States (Wilson 1996). However, the fragmentation of forested uplands adjacent to peatlands may provide egg and nest predators, such as common grackles (Quisculus quiscula) and raccoons (Procyon lotor), with greater access to palm warbler nests (Wilson 1996).

Palm warblers are nocturnal migrants. They are one of the most frequently killed migrants in collisions with television towers and other tall and lighted buildings and structures. Over a 25-year period, a single television tower in Florida was responsible for 2,305 palm warbler deaths, mostly during the fall migration. This number represents 5.4% of all birds killed by the tower (Wilson 1996).

1.3 Protection and Regulatory Status

Palm warblers are protected under the Federal Migratory Bird Treaty Act (1918).

1.4 Population and Habitat Distribution

Palm warblers are among the most northerly of the Dendroica warblers, nesting mostly in bogs and fens in boreal forests across much of Canada and the northern United States (Wilson 1996). In New England, palm warblers nest in central and northern Maine and in northern New Hampshire (Richards 1994). Richards documented the first likely breeding record for New Hampshire in 1957 by observing 2 palm warblers, one of which was carrying food to Floating Island Bog at Harper's Meadow in Errol. In August 1980, Richards recorded the first observation of a juvenile with remnant down at the same bog as an adult (Richards 1994). Richards (1994) identified no 'confirmed' or 'probable' breeding records for palm warblers in New Hampshire, although single birds were seen in a stand of northern white cedar on a low ridge near Floating Island Bog in Errol and Dummer.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Peatlands Habitat Mapping (element 1.6)

1.7 Sources of Information

NatureServe (2005) was used for status and ranking information. Recent distribution data are from the NHBR database, maintained by NHA, and from Richards (1994). Distribution, habitat, and life history information were taken from published literature including Richards (1994).

1.8 Extent and Quality of Data

Palm warblers appear to be limited to a few semi-open bogs in northern New Hampshire, mostly because the species reaches the southeastern edge of its breeding range here. Much of the preferred bog habitat is barely accessible to observers and the species may occur more often than records indicate (Richards 1994). In addition, palm warblers are difficult to relocate even if they are close to previous nesting sites (Richards 1994).

1.9 Distribution Research

Since palm warbler records are few in New Hampshire, known breeding locations can be checked annually. Palm warblers can be included in comprehensive peatland habitat inventories and monitoring.

Element 4: Conservation Actions

See Peatlands profile for conservation actions. Maintaining intact uplands around peatlands may prevent increased nest mortality from predators associated with fragmentation.

Element 5: References

5.1 Literature

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5.2 Data Sources

New Hampshire Bird Records database. Maintained by New Hampshire Audubon, Concord, New Hampshire, USA. (Accessed 30 March 2005)

SPECIES PROFILE

Peregrine Falcon

Falco peregrinus

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G4
State Rank: S1

Author: Christian J. Martin, New Hampshire Audubon

Element 1: Distribution and Habitat

Habitat Description

The peregrine falcon is a wide-ranging species that uses many different habitats across the United States for breeding, wintering, and migration. Open landscapes and air spaces, where peregrine falcons can locate and attack their prey in the air, are important components of most habitat types. Peregrine falcons in cliff habitats are often generalist feeders, preying on medium-sized birds roughly in proportion to their local abundance. Peregrine falcons sometimes travel several miles from cliffs to obtain prey. Preferred habitats include mountainous terrain, agricultural land, wide river valleys, lake shorelines, ocean coastlines, and islands (White et al. 2002). The urban environment, with high-rise buildings, major bridges, and tall smokestacks, has become an increasingly important habitat for peregrine falcons within the past quarter century (Cade et al. 1996b).

The home range of a territorial individual can be relatively small (100 km^2) when prey populations are abundant, but may be much larger (350 to 1,500 km^2) when prey populations are more dispersed (White et al. 2002). Peregrine falcons prefer to raise young on vertical cliffs or on man-made structures that possess physical characteristics similar to cliffs. Peregrine falcons can potentially establish breeding territories anywhere in the United States provided that areas with suitable nest sites and sufficient prey base occur in close proximity.

1.2 Justification

Peregrine falcons historically established breeding territories in relatively low densities in suitable cliff habitats throughout the United States. Between the late 1800s and the early 1940s, many cliff breeding sites in the eastern half of the country were identified and documented (Hickey 1942). Extensive reproductive failure caused by increasing levels of persistent synthetic chlorinated hydrocarbons (DDT and others) in their avian prey caused a dramatic population decline and range reduction starting in the late 1940s and continuing through 1970 (Hickey 1969, Enderson et al. 1995). In New Hampshire, peregrine falcons ceased to breed productively by the late 1950s and all known nesting areas in the state became vacant by the mid-1960s (Spofford 1975). By the late 1960s, peregrine falcons no longer occupied any historical breeding sites in states east of the Rocky Mountains (Cade et al. 1988). A massive restoration program began in the mid-1970s and was unprecedented in scope and scale. This effort resulted in the gradual recovery and re-occupancy of vacant historical territories in New Hampshire and across the United States starting in the early 1980s and continuing to the present day (Cade and Burnham 2003).

1.3 Protection and Regulatory Status

The peregrine falcon is protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the possession or killing of most non-game birds and the collection of their eggs or nests. The American peregrine falcon, (F. p. anatum), the subspecies which formerly occupied the eastern United States, was first listed as Endangered by the federal government in 1970 under the Endangered Species Conservation Act of 1969 (Public Law 91-135, 83

Stat. 275). This authority was later transferred to the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.). Since 1979, the species has been listed as Endangered by the State of New Hampshire (R.S.A. 212-A:1 et seq.).

As a result of the population recovery throughout the United States during the 1980s and 1990s, the American peregrine falcon was removed from the federal Endangered Species List in 1999 (Mesta 1999). As required for any delisting under the ESA, the United States Fish and Wildlife Service (USFWS), in cooperation with state wildlife agencies, developed and implemented a post-delisting monitoring plan to track the post-delisting status of peregrine breeding populations in the United States through 2015 (Green et al. 2003).

Other federal protective measures that continue after delisting under ESA include those offered by the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136) for new and existing pesticide registration and use, the National Forest Management Act (16 U.S.C. 1600), and the Federal Land Management and Policy Act (43 U.S.C. 1701) (Green et al. 2003). Peregrine falcons are protected from unregulated international trade by an agreement of the 1975 Convention on International Trade in Endangered Species of Wild Flora and Fauna.

1.4 Population and Habitat Distribution

Cliffs are abundant in New Hampshire. Suitable nesting substrate does not appear to be a limiting factor in peregrine falcon distribution. Prior to the mid-1940s, at least 350 peregrine falcon pairs were estimated to breed at sites in the eastern United States (Hickey 1942). Following extirpation of the original F. p. anatum population in the region, biologists released approximately 2500 captive-produced young (consisting of at least seven F. peregrinus subspecies) to the eastern United States starting in 1974 (Tordoff and Redig 2001). The Eastern Peregrine Falcon Recovery Plan, first developed in 1979, designated northern New York and northern New England (i.e., the Adirondacks and most of Maine, New Hampshire, and Vermont) as Recovery Region 2 (USFWS 1987). Recovery Region 2 contained about 85 territorial pairs prior to the early 1940s (Hickey 1942), but no pairs from the mid-1960s through 1980 (Berger et al. 1969).

Through the mid-1950s, all documented peregrine falcon territories in New Hampshire were associated with cliffs. Most sites were scattered throughout the White Mountains from the west central to the far northeastern parts of the state (Table 1). The now recovering population occupies territories in a similar pattern, occurring mostly in the White Mountains with a few additional occupied cliffs in the far north and one urban site in southern New Hampshire (Table 1 and Figure 1). Recovery data for individually marked peregrine falcons clearly show that individuals breeding in New Hampshire are not isolated from those breeding in other New England states, but instead are part of an interconnected regional population (Barclay 1995, M. Amaral, USFWS, personal communication).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Cliff habitat profile.

1.7 Sources of Information

General natural history information and some sources of original research were obtained primarily from White et al. (2002). Unless otherwise noted, the source for New Hampshire species data is field monitoring and management activities conducted by the New Hampshire Audubon (NHA) from 1983 though 2004 under annual contracts and/or grants received from the New Hampshire Fish and Game Department (NHFG) and/or the USFWS (e.g., Martin 1993, Martin 2004).

1.8 Extent and Quality of Data

Since the early 1980s, the peregrine falcon has been one of the most intensively monitored and managed species in New Hampshire (see Appendix 1 for example of detailed data available for each documented breeding site). Breeding site data are derived from 2 decades of field monitoring by NHA staff and trained volunteers. These observers employ standardized monitoring techniques at historical, active, and other potential sites throughout the state (see Cade et al. 1996a). Remote sites and sites located close to roads and trails are surveyed, although remote sites are visited less frequently.

1.9 Distribution Research

Spring surveys of recently active and potential breeding sites should be used to monitor the distribution and abundance of peregrine falcons in New Hampshire. Recently active sites should be checked annually to determine occupancy status and reproductive outcome. Surveys of potential sites should be conducted on a rotating basis, with annual survey intensity determined by funding and available human resources. For example, sites could be checked on a 3-year rotation covering 33% of sites annually, on a 5-year rotation covering 20% annually, or on a 10-year rotation covering 10% annually. New Hampshire should continue to participate in the federal post-delisting monitoring program established by the USFWS to track the status of a subset of the breeding population across the United States in 2006, 2009, 2012, and 2015 (Green et al. 2003).

Element 2: Species/Habitat Condition

2.1 Scale
See Cliff Habitat Profile.

2.2 Relative Health of Populations

New Hampshire's 17 documented historical breeding territories and 18 recently occupied breeding territories are listed in Table 1. Of the 17 historical territories documented in the state, 5 (29%) have been reoccupied while 12 (71%) were unoccupied between 1970 and 2004. Thirteen recently occupied territories have no documented record of historical use, suggesting that the number of territories in the state prior to 1950 was underestimated. Table 2 documents the temporal pattern of territory occupancy in New Hampshire beginning in 1981. During the 10-year period from 1985 to 1994, the breeding population expanded at an annual rate of 15.9%. From 1995 to 2004, the population continued to expand, but at a less vigorous annual rate of 3.6%. The population is continuing to grow. The highest numbers of occupied territories, territorial pairs, nesting pairs, successful pairs, and number of young fledged in the post-DDT era have all been attained within the past three breeding seasons.

2.3 Population Management Status

Volunteers from NHA conduct productivity monitoring and presence/absence surveys of approximately 30 potential peregrine falcon breeding sites. Other activities include salvage of eggs and chicks, evaluation and management of human (i.e., recreational) influences, internet broadcasting of nesting activity, and extensive outreach and education to the public and rock-climbing community.

2.4 Relative Quality of Habitat Patches

All peregrine falcon breeding sites are cliffs except the site on the New Hampshire Tower in the City of Manchester. Potential and currently occupied cliff sites in New Hampshire appear to provide the key ecological attributes required to support a healthy breeding population. Of 172 documented incubation attempts on cliffs in New Hampshire from 1981 to 2004, 134 (78%) took place directly on rock ledges, 34 (20%) were in former common raven nests, and 4 (2%) occurred on undetermined substrates. The greatest concern for habitat quality at cliff sites is the growing popularity of recreational climbing and its potential to suppress nesting success and productivity.

Each of the four known urban nesting attempts occurred in a human-built nesting box. The number of potential urban nesting sites is expected to increase (10-20 currently exist) with increasing development. Peregrine falcons use tall office buildings, church steeples (e.g., in Nashua, Manchester, Concord, and Berlin), major industrial buildings, tall smokestacks, large dams (e.g., Seabrook Station, Merrimack Station, Newington Station, Nexfor Paper Mill, Moore Dam, and Comerford Dam), and substructures of the state's largest bridges (e.g., Interstate 95 at Piscataqua River, Route 16/4 at Little Bay mouth, Route 9 at Connecticut River, Route 101/293 at Merrimack River). The most serious habitat quality concerns at urban sites are pigeon abundance, the potential risk of secondary poisoning due to pigeon control efforts, the limited availability of suitable nesting substrates, and the highly variable maintenance schedules of urban structures.

2.5 Habitat Patch Protection Status

Of 15 occupied peregrine falcon breeding territories in New Hampshire in 2004, 11 sites (73%) were on public land, 3 (20%) were on private land, and one (7%) was on a mix of public and private land. Of the 11 sites on public land, 6 sites were managed by the United States Forest Service, 4 were on state land managed by the New Hampshire Division of Resources and Economic Development, and one was on municipal land managed by the Town of Woodstock. Of the 3 sites on private land, one was protected by a conservation easement, while 2 were not. Fifteen sites were cliff habitat, and one was urban habitat.

2.6 Habitat Management Status

Cliff habitats in New Hampshire are subject to very little direct habitat management. There are no efforts to promote or discourage any particular vegetation type or density on cliffs. Establishing temporary restrictions for the recreational use of cliffs is the only current management action. Urban habitat management consists of voluntary adjustments in building maintenance to avoid potentially disruptive activities such as window washing or antenna construction during the breeding season.

2.7 Sources of Information

Information on New Hampshire's peregrine falcon population and habitat is derived directly from summary reports and field data on monitoring and management activities conducted by NHA from 1983 though 2004 under annual contracts and/or grants from the NHFG and/or the USFWS (e.g., Martin 1993, Martin 2004).

2.8 Extent and Quality of Data

Peregrine falcons have been listed as Endangered on both federal and state lists for much of the past four decades, and so there is a relatively complete data set on occurrence, productivity, and habitat condition. Annual summaries of this information are on file at the NHFG.

2.9 Condition Ranking

2.10 Condition Assessment Research

The population of peregrine falcons in northern New England has been individually marked. Band resighting helps collect critically important and hard-to-acquire data on dispersal patterns and population demography, individual longevity, and nest site fidelity. It links contaminant data from eggs to individual female peregrine falcons of known age and reproductive history.

Element 3: Species and Habitat Threat Assessment

3.1.1 Recreation

(A) Exposure Pathway
Human presence near nest sites provokes aggressive defensive behaviors, limiting incubation, brooding, or feeding, and increasing chick exposure to temperature fluctuations and predation. These factors may also result in higher mortality and reduced productivity due to premature fledging of young.

(B) Evidence
Peregrine falcons nesting in remote areas are intolerant of human encroachment (Cade et al. 1996a). Recreational rock climbing activity and hiking on or near cliffs can produce aggressive nest defense behaviors (Lanier and Joseph 1989, Pyke 1997). The popularity of recreational rock climbing has grown exponentially in northern New England during the post-DDT era and is becoming a serious problem for land managers trying to protect nesting peregrine falcons (Mesta 1999). Few cliffs in New Hampshire are free from fixed climbing hardware, including cliffs in federally designated wilderness areas that are located as far as 4 miles from the nearest roadside trailhead.

3.1.2 Non-point Source Pollution

(A) Exposure Pathway
Various neurotoxins accumulate in animal tissues and are magnified in predatorial trophic webs, with ingestion by top predators producing reproductive, behavioral, neurological, and physiological stresses. These changes lead to reduced vigor and breeding

success (Evers 2005, Sharp and Lunder 2004). Organochlorine pesticides, most notably DDT, accumulate in animal tissue and are magnified in predatorial trophic webs, causing lethal and sub-lethal effects in peregrine falcons.

(B) Evidence
Brominated fire retardants, commonly known as PBDEs, are similar in chemical structure to PCBs. They are used in a wide range of synthetic household and consumer products. PBDEs have been shown to be accumulating in wildlife populations worldwide, and some of the highest concentrations yet documented occur in peregrine falcon populations in the United Kingdom (European Union 2003).

Elevated levels of organochlorine pesticides are still being detected in some North American peregrine falcon populations and pose a possible risk to sustained recovery (Mesta 1999). Even though these chemicals have been banned for sale and use in North America, their use continues to be largely unrestricted in Latin America. DDT residues continue to be detected in some migratory songbird populations and toxic residues in avian prey species can cause lethal and sub-lethal effects in peregrine falcons, including eggshell thinning that results in a loss of productivity (Cade et al. 1988, White et al. 2002). There are direct correlations between concentrations of DDE residues in egg contents and eggshell thickness (Peakall and Kiff 1988).

3.1.3 Mercury

(A) Exposure Pathway
Mercury bioaccumulates in much the same way as other persistent toxins. See 3.1.2 above.

(B) Evidence
Mercury levels are high and pervasive in the aquatic food webs and terrestrial systems of northeastern North America (Evers 2005). Current research shows that even forest songbird populations have elevated mercury burdens (Rimmer et al. 2005).

3.1.4 Energy and Communication Infrastructure

(A) Exposure Pathway
Construction associated with the building of cellular towers and wind turbines may limit incubation, brooding, or feeding, and increase chick exposure to temperature fluctuations and predation. These factors may lead to higher mortality and reduced productivity due to premature fledging of young. Death or serious injury may result when peregrine falcons collide with towers, supporting wires, and/or wind turbine blades.

(B) Evidence
Activities on the tops of nesting cliffs tend to be more disruptive than similar activities below cliffs (Cade et al. 1996a). Construction that involves road building, logging, and blasting is potentially disruptive to nesting peregrine falcons and needs to be controlled roughly one half mile from nest sites (Cade et al. 1996a). Collisions with structures and support wires are a known source of mortality for fledglings and after hatch-year peregrine falcons (White et al. 2002).

3.2 Sources of Information

Information on threats to peregrine falcons was obtained from a literature review, from NHA field data, and from consultation with specialists from the USFWS and NHA in Concord, New Hampshire, and from BioDiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

Researchers working outside of New Hampshire examined most of the threats to peregrine falcons described above. There are sufficient data on the climbing and hiking threat in New Hampshire to justify concern and warrant management actions. The potential effects of mercury and PBDEs on terrestrial species are just now gaining the attention of researchers nationwide. Egg samples in the archives of the USFWS could potentially produce New Hampshire data to assess this issue. Threats related to exposure to DDT and other organochlorine pesticides are well documented, including data from New Hampshire. There is no data specific to New Hampshire on the effects of cellular tower/wind turbine construction or operation. With relatively little data nationwide, this topic warrants further field investigation.

3.4 Threat Assessment Research

Investigate the tolerance thresholds of peregrine falcons for recreational rock climbing activity in the vicinity of nest sites, and examine the impacts of climbing activity on the cliff habitat in general. Analyze archived peregrine falcon egg and prey remains to produce data specific to New Hampshire on current levels of mercury, PCBEs, DDE, and other bio-accumulative pollutants. Investigate the likely future extent of cellular tower/wind turbine construction and operation in New Hampshire to determine their potential impact on peregrine falcons and other cliff-dwelling wildlife. Develop guidelines for the location, construction, and operation of these facilities.

Element 4: Conservation Actions

4.1.1 Monitor Threatened and Endangered Breeding Status, Monitoring

4.1.2 Develop State Recovery Plan, Regulation and Policy (see Strategies, Agency Regulation and Policy)

4.1.3 Advise ESA Recovery Efforts, Regulation and Policy (see Strategies, Inter-Agency Regulation and Policy)

4.1.4 Cultivate Recreational User Stewardship, Education and Outreach (see Cliff Habitat, see also Strategies, Education and Outreach)

4.1.5 Advise Land Managers on Mitigation of Recreational Impacts, Regulation and Policy (see Cliff Habitat, see also Strategies, Inter-Agency Regulation and Policy)

4.1.6 Identify High Risk Areas for Recreation, Wind Energy, and Pollutants, Conservation Planning see Strategies, Conservation Planning)

4.1.7 Engage in Inter-Agency Risk Assessments for Recreation, Wind Energy, and Pollutants, Regulation and Policy (see Strategies, Inter-Agency Regulation and Policy)

4.1.8 Restrict Access to High Risk Areas, Regulation and Policy (see also Strategies, Inter-Agency Regulation and Policy)

4.1.9 Advise Wind Energy Developers on Best Management Practices for Construction, Regulation and Policy (see Strategies, Inter-Agency Regulation and Policy)

4.1.10 Prioritize Cliffs for Protection, Land Protection (see Strategies, Conservation Planning)

4.1.11 Protect Unfragmented Blocks, Land Protection (see Strategies, Land Protection)

4.1.12 Monitor as an Indicator of Bio-Accumulation of Contaminants, Monitoring (see Strategies, Monitoring)

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5.2 Data Sources

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Element 6: List of Figures

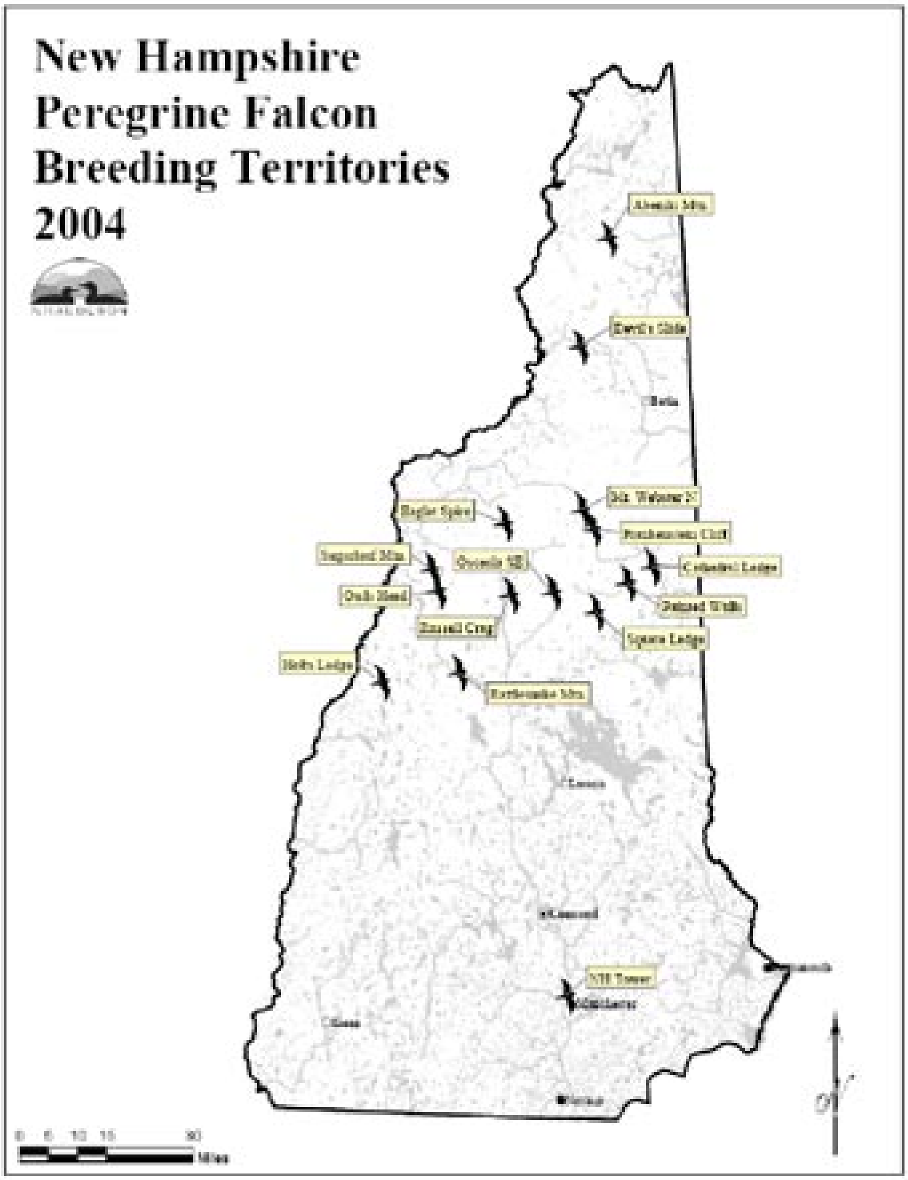

Figure 1. Distribution of peregrine falcon breeding territories in New Hampshire in 2004.

Breeding site	NH Township	Most recent documented occupancy
Unoccupied since 1970, but with documented prior historical use		
Baldface	Beans Purchase/Chatham	no specific date given
Black Mtn.	Benton	no specific date given
Percy Peaks	Stratford	no specific date given
Moat Mtn.	Albany	1870
Humphreys Ledge	Bartlett	1902
Sugarloaf	Alexandria	1927
Mt. Monadnock	Jaffrey	1938
Ragged Mtn. Bulkhead	Andover	1939
Pond Ledge	Haverhill	1940
Polar Caves	Rumney	1949
Peaked Mtn.	Piermont	1954
Mt. Kilburn	Walpole	1955
Occupied since 1970 with documented prior historical use		
Cathedral/White Horse	Bartlett	1986-89, 1997-2004
Holts Ledge	Lyme	1987-2004
Owls Head	Benton	1993-2004
Rattlesnake Mtn.	Rumney	1994-2004
Diamond Peaks	2nd College Grant	1997-1999
Occupied since 1970, but with no documented prior historical use		
Eagle/Eaglet/Cannon	Franconia	1981-2004
Square Mtn.	Kilkenny	1984-1998
Frankenstein Cliff	Harts Location	1985-2004
Willard/Webster	Harts Location	1985-1995, 1997-1998, 2001-2004
Abeniki Mtn.	Dixville	1988-2004
Painted Walls	Albany	1989-1990, 1993-2004
Square Ledge	Albany	1991-1992, 1995-2004
Devils Slide	Stark	1994-2004
Osceola East/South	Livermore	1995, 1999-2004
Beaver Pond Cliff	Benton	1998
New Hampshire Tower	Manchester	2000-2004
Russell Crag	Woodstock	2002-2004
Sugarloaf Mtn.	Benton	2004

Table 1. Historical and recent peregrine falcon breeding sites in New Hampshire.

Year	Occupied Territories	Territorial Pairs	Nesting Pairs	Successful Pairs	Young Fledged	Young fledged/ nesting pair
1981	1	1	1	1	2	2
1982	1	1	1	0	0	0
1983	1	1	1	0	0	0
1984	2	0	0	0	0	0
1985	4	4	3	2	5	1.67
1986	5	5	4	4	9	2.25
1987	6	6	5	1	2	0.4
1988	7	7	4	2	3	0.75
1989	8	7	7	5	10	1.43
1990	7	7	7	4	11	1.57
1991	7	6	6	3	7	1.17
1992	7	7	7	3	5	0.71
1993	8	8	7	5	11	1.57
1994	10	9	8	5	10	1.25
1995	11	11	10	8	15	1.5
1996	9	9	8	5	13	1.63
1997	12	11	10	6	16	1.6
1998	12	10	10	7	16	1.6
1999	12	11	9	8	25	2.78
2000	11	10	10	10	25	2.5
2001	13	12	12	10	22	1.83
2002	14	14	14	9	27	1.93
2003	14	14	14	10	21	1.5
2004	15	13	11	8	15	1.36
24 yrs	**197**	**184**	**169**	**116**	**270**	**1.6**

Table 2. New Hampshire peregrine falcon productivity summary: 1981-2004.

SPECIES PROFILE

Piping Plover

Charadrius melodus

Federal Listing: Threatened
State Listing: Endangered
Global Rank: G3
State Rank: S1
Author: Allison M. Briggaman, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

"Piping plovers nest above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes" (United States Fish and Wildlife Service (USFWS) 1996).

1.2 Justification

Before the Migratory Bird Treaty Act of 1918, unregulated hunting caused the decline of the Atlantic coast piping plover population (USFWS 1996). Since the 1940s, the piping plover population has steadily declined due to increased development along the Atlantic coast. This development boom has increased habitat loss and degradation, human disturbance, and predation, all of which have contributed to species decline. These factors have affected the piping plover along the entire Atlantic coast, from Nova Scotia to North Carolina (USFWS 1985, Haig 1992). Though the piping plover was absent for several years along the New Hampshire coast, it was discovered nesting again in 1996.

The Atlantic coast piping plover population is the aggregate of many small groups with many breeding sites, with each site having fewer than 10 breeding pairs (A. Hecht, USFWS, personal communication). Therefore, even protecting breeding locations with only a few pairs is crucial to maintaining the integrity of the overall population.

1.3 Protection and Regulatory Status

- Federal Endangered Species Act (ESA) of 1973
- Federal Migratory Bird Treaty Act of 1918
- New Hampshire RSA 212-A:6 IV(a) Endangered Species Conservation Act

1.4 Population and Habitat Distribution

The Atlantic coast piping plover population breeds from Nova Scotia south to North Carolina. They are monogamous and territorial during the breeding season with pairs staying together to help raise their young.

New Hampshire Fish and Game (NHFG) began a piping plover protection effort in 1997. Since then, piping plovers have consistently nested on the beaches and dunes along the Atlantic coast in the towns of Hampton and Seabrook. One to 2 pairs have consistently nested north of Hampton Harbor Inlet and 1 to 5 pairs have consistently nested south of Hampton Harbor Inlet (NHFG data).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Dune habitat profile

1.7 Sources of Information

Information on piping plover habitat, population distribution and status was collected from recovery plans, USFWS data, NHFG data, scientific journals and the Coastal Sand Dune Systems map produced for this process.

1.8 Extent and Quality of Data

Piping plovers have been intensively managed throughout their breeding range along the East coast since their listing under the Endangered Species Act (ESA) in 1986. In New Hampshire, breeding habitat has been managed and piping plovers have been monitored annually since 1997.

1.9 Distribution Research

Continue monitoring efforts during the breeding season and continue to participate in the Atlantic Coast annual census.

Element 2: Species/Habitat Condition

2.1 Scale

The Coastal Sand Dunes map produced for this process identified 13 habitat patches along the New Hampshire coast. Two of these patches provide suitable piping plover breeding habitat and span approximately 2 miles of the New Hampshire coast. These areas fall within two towns: Hampton and Seabrook. In Hampton, piping plovers have been observed to nest with varying success at Hampton Beach State Park since the Piping Plover Protection Effort began in 1997. Birds have tried to nest on town land but have been unsuccessful.

In Seabrook, suitable habitat occurs along Seabrook Town Beach where plovers have nested consistently since 1997. Although plovers have historically nested in the Seabrook Harbor, no nesting has been documented since 1997.

Sand dunes likely comprised a much greater amount of the immediate coast before the increased development of recent decades. The remaining 10 habitat patches identified by the Coastal Sand Dunes mapping process are primarily state owned areas (i.e. State Parks). These areas provide potential locations for dune habitat restoration.

2.2 Relative Health of Populations

Piping plovers that breed along the New Hampshire coast are part of the greater Atlantic Coast population. The Atlantic Coast population will be considered recovered when 2,000 breeding pairs are maintained for 5 years and are distributed throughout 4 recovery units, as delineated by the USFWS Piping Plover Atlantic Coast Population Revised Recovery Plan (1996). As of 2003, the Atlantic coast population was 324 pairs short of that goal (USFWS 2004a).

New Hampshire falls within the New England recovery unit that must achieve and maintain 625 breeding pairs to meet the recovery goal (USFWS 1996). This goal was attained in 1998 when 627 breeding pairs were recorded. Each year since, the goal has been met or exceeded, except for 1999 and 2000 when the total count dropped by 3 and 4 pairs respectively (see table 1) (USFWS 2004a). Preliminary estimates for 2004 indicate 659 pairs for the New England recovery unit (USFWS 2004b).

According to population monitoring by S.M. Melvin and J.P. Gibbs (1994), a minimum of 1.24 chicks fledged per pair is necessary to maintain a stationary population. However, the USFWS Piping Plover Atlantic Coast Population Revised Recovery Plan states that a higher productivity rate of 1.50 chicks fledged per pair is necessary to prevent extinction and maintain a population of 2000 breeding pairs (USFWS 1996).

Since 1997, when the Piping Plover Protection Effort began in New Hampshire, between 5 and 7 pairs have nested annually along the coast and have fledged a total of 72 chicks. Productivity for piping plovers in New Hampshire has varied between 0.1 and 2.7 chicks fledged per pair each year with the average productivity totaling 1.5 between 1997 and 2004.

2.3 Population Management Status

Piping plovers are monitored each year throughout the breeding season. Nest sites are located and protected from trampling and predation with fenced exclosures. Chicks are monitored daily from hatching to fledging, and recreational activities are managed in breeding areas to prevent disturbance. Beach management activities such as beach raking and boardwalk maintenance are coordinated with local, town, state and federal officials.

2.4 Relative Quality of Habitat Patches

Thirteen habitat patches are identified in the Coastal Sand Dunes map produced for this process. Of these, 3 are known to provide suitable habitat and to be occupied by breeding piping plovers. The remaining 10 habitat patches either provide potential habitat or feeding areas or are potential dune habitat restoration locations.

2.5 Habitat Patch Protection Status

Three of the habitat patches identified in the Coastal Sand Dunes map created for this process are known piping plover breeding areas and are protected under Federal and State Threatened and Endangered Species Laws (see element 1.3 above). The remaining 10 habitat patches identified are state owned lands, primarily State Parks, and are open to the public for recreational uses. Coastal sand dune systems are protected under the Federal Coastal Zone Management Act (1972) and NH RSA 482-A pertaining to Fill and Dredge in Wetlands. Refer to the Dune habitat profile for more information.

2.6 Habitat Management Status

In areas where piping plovers are known to occur, habitat management protects nesting areas during the breeding season. Management activities include fencing suitable habitat areas during the breeding season, restricting motorized vehicle use and coordinating beach management activities, such as beach raking and boardwalk maintenance. Habitat management is conducted by NHFG according to USFWS Atlantic Coast Piping Plover Population Revised Recovery Plan guidelines and in cooperation with town officials.

Coastal sand dune systems are managed by local towns and New Hampshire State Parks, and are managed primarily for recreation. For more information on coastal sanddune system habitat management, refer to the Dune habitat profile.

2.7 Sources of Information

Information on habitat protection and management was obtained from NHFG piping plover monitoring data and annual reports, personal communication, and the Dune habitat maps created for this process.

2.8 Extent and Quality of Data

Piping plovers have been intensively managed throughout their breeding range along the East coast since their listing under the Endangered Species Act (ESA) in 1986. In New Hampshire, occupied breeding habitat has been managed, and piping plovers have been monitored annually since 1997.

Information on the location of coastal sand dunes and associated natural plant communities is available from New Hampshire Natural Heritage Inventory (NHNHI) . However, there is a lack of information available about the overall health and condition of coastal sand dune systems and piping plover breeding habitat.

2.9 Condition Assessment Research

Continue monitoring to determine annual productivity.

Element 3: Species and Habitat Threat Assessment

3.1.1 Recreation

A) Exposure Pathway
Coastal sand dune systems comprise less than 2 miles of the State's 18.57 miles of shoreline (New Hampshire DES 2004, Coastal Sand Dune Systems habitat map). These limited dune areas not only provide suitable habitat for breeding piping plovers, but they also receive severe pressure from human recreational activities, including sunbathing, swimming, jogging, dog walking, kite flying, volleyball, jet skiing, surfing and fishing. Human presence in coastal sand dunes leads to increased disturbance, increased stress, reduced productivity and direct mortality of breeding piping plovers and their chicks. Human disturbance causes plovers to flush from nests, which results in less incubation time and exposes eggs to extreme temperatures. When this happens, eggs may no lon-

ger be viable, or they may not develop fully, and this can lead to the adults abandoning the nest. Human presence can also cause direct mortality, as when nests or chicks are trampled. Furthermore, human refuse attracts predators, causing increased disturbance, increased stress, reduced productivity and direct mortality of breeding piping plovers.

(B) Evidence:
During summer 2003, Hampton Beach State Park reported 122,890 visitors (J. Lyons, New Hampshire Department of Resource and Economic Development, personal communication). Such intense usage is clearly problematic, since disturbance of piping plovers by humans and their pets is one of the primary reasons for their listing under the Endangered Species Act. Nor are visitor numbers likely to fall. Beach walking is the second most popular recreational activity, and as populations rise, beach usage will increase proportionately (NSRE 1994). Thus, if human recreational activities are not effectively managed in piping plover breeding areas, it is unlikely that piping plovers will successfully breed.

3.1.2 Recreation (Off Road Vehicles)

(A) Exposure Pathway
Although only beach cleaning equipment and essential vehicles are allowed on New Hampshire beaches, these vehicles can crush piping plover eggs, chicks and adults. Removal of human-created trash on the beach is desirable to reduce predation threats, but the indiscriminate nature of mechanized beach cleaning adversely affects piping plovers and their habitat. In addition to the danger of direct crushing of piping plover nests and chicks and the prolonged disturbance from the machine's noise, this method of beach cleaning removes the birds' natural wrackline feeding habitat (Eddings and Melvin 1991, Howard et al. 1993).

(B) Evidence:
The USFWS (1996) has identified unrestricted motorized vehicles as a serious threat to piping plovers and their habitats. Piping plover mortality due to motorized vehicles has been well documented throughout its breeding range. In New Hampshire, there is one documented instance and several suspected instances of piping plover mortality due to motorized vehicles (New Hampshire Fish and Game unpublished data).
Soon after hatching, chicks are very mobile, moving between intertidal zones and dunes and along the length of beaches. This errant nature, combined with the chicks' inability to fly, leaves them particularly vulnerable to injury by motor vehicles. Vehicles also significantly degrade piping plover habitat or disrupt normal behavior patterns. They may harm or harass plovers by crushing wrack into the sand and making it unavailable as cover or a foraging substrate (Hoopes et al. 1992, Goldin 1993), by creating ruts that can trap or impede movements of chicks (USFWS 1996).

3.1.3 Predation and Herbivory (Subsidized or Introduced Predators)

(A) Exposure Pathway:
Piping plovers face a variety of predators, both natural and domesticated. Known predators of piping plovers, their eggs, and chicks along the New Hampshire coast include fox, striped skunk, crows, ravens, gulls, common grackles, and domestic and feral dogs and cats. Domestic dogs in particular pose significant threats to breeding plovers in New Hampshire. Although dogs are prohibited on Town beaches and State Park beaches between Memorial Day and Labor Day, a lack of enforcement allows dogs to be walked daily. Additionally, many property owners along Seabrook Town Beach are summer residents who bring their cats and leave them outside for the summer to roam freely. Some property owners in both Seabrook and Hampton even provide feeding stations for feral cats, thus increasing the risk of predation in piping plover breeding areas. Meanwhile, other birds such as the herring, great black backed and ring billed gulls encroach on piping plover territory and may cause them to abandon their nests (USFWS 1996).

(B) Evidence
Predation is a major and well-documented threat to piping plover reproductive success along the Atlantic coast (Burger 1987, MacIvor 1990, Patterson et al. 1991, Cross 1991, Elias-Gerken 1994). Likewise, evidence is plentiful that human activity has caused predation pressures to increase (USFWS 1996).

In New Hampshire, gulls, cats, and dogs are the most commonly observed predators, with feral cats and domestic dogs posing the most significant threats to piping plover productivity and survival. Cats have been documented in piping plover breeding areas at both Hampton and Seabrook, and cats are the suspected cause of the death of several chicks and at least 1 adult. Dogs have been observed running freely through areas restricted for piping plovers, defecating and flushing piping plovers along the beaches. (NHFG, unpublished data). Similarly, large flocks of gulls have been observed feeding in piping plover breeding habitat, thus preventing plovers and their chicks from foraging.

3.1.4 Development

(A) Exposure Pathway
See Dune habitat profile, Element 3 section 3.1.2 Development (Habitat Loss and Conversion)

(B) Evidence
See Dune habitat profile, Element 3 section 3.1.2 Development (Habitat Loss and Conversion)

3.2 Sources of Information
Information on piping plover threats was taken from the USFWS Atlantic Coast Piping Plover Population Revised Recovery Plan, NHFG data, scientific journal articles, and personal communications and observations.

3.3 Extent and Quality of Data

Threats to breeding piping plovers along the Atlantic Coast have been cited as reasons for the species listing under the Endangered Species Act and have been well documented throughout their breeding range.

3.4 Threat Assessment Research

Potential threat assessment research would accomplish the following:

- Evaluate different management practices to determine the most effective human use management strategies in piping plover breeding areas
- Investigate different predator control methods and implement a predator control management protocol
- Identify and obtain funding to support a part time animal control officer to patrol beaches and enforce animal control laws and possibly carry out predator control management protocol
- Work with town officials to determine necessary actions and begin enforcing town regulations regarding use of unofficial pathways over dunes/town property during piping plover breeding season

Element 4: Conservation Actions

4.1.1 Improve enforcement of existing laws and regulations, Regulation and Policy

(A) Human disturbance

(B) Justification

- Enforcement of existing laws will reduce human disturbance to breeding piping plovers by reducing the number of dogs in the breeding areas and reducing human foot-traffic on unofficial paths over the dunes.
- Reducing human disturbance to breeding piping plovers will reduce the amount of time incubating birds are disrupted from the nests, reduce the occurrences of nest abandonment, reduce the risk of eggs/chicks being trod on by humans and their pets and thus foster increased productivity.
- Improving enforcement of existing laws and regulations should be focused on the breeding areas.
- Improving enforcement of existing laws and regulations should be maintained year round for consistency. Enforcement should increase during the breeding season, which corresponds with peak human recreational activities.

(C) Conservation Performance Objective
Improve enforcement of existing laws and regulations to increase annual productivity among breeding piping plovers by reducing disturbance from humans and their pets. Successful reduction of human disturbance will be indicated by a reduction of the number of people walking dogs on the beaches, a reduction of the number of unofficial paths leading from private residences over the dunes and into breeding areas and a reduction in the frequency of use of fireworks on the

beaches at night.

(D) Performance Monitoring
Daily monitoring of piping plovers during the breeding season will continue, and will include information about the number, location, and activities of the birds as well as documentation of human disturbance and its effect on breeding piping plovers.

(E) Ecological Response Objective
The desired ecological response to improved enforcement of existing laws and regulations is to maintain productivity at 1.50 or more chicks fledged per pair each year. This level of productivity will sustain a population of 625 breeding pairs in the New England region and will contribute to the desired 2000 breeding pairs in the Atlantic Coast piping plover population, as outlined in the Atlantic Coast Piping Plover Revised Recovery Plan of 1997, by the USFWS.

(F) Response Monitoring
See section D above.

(G) Implementation
The New Hampshire Fish and Game, together with the USFWS and local officials at the town level should find funding for additional personnel to enforce existing town regulations and state and federal endangered species laws. Enforcement should be carried out year-round with an increase in enforcement during the summer months to correspond with piping plover breeding and the peak of recreational beach use.

(H) Feasibility
The expertise to improve enforcement of existing laws and regulations exists at the town, state and federal levels. However, lack of personnel and funding to support additional personnel has prevented adequate enforcement of town laws and state and federal endangered species laws.

4.1.2 Education and Outreach to residents, day visitors, community and town officials, Education and Outreach

(A) Human disturbance and Predation

(B) Justification

- Education and outreach to residents, day visitors, community and town officials will help to reduce human disturbance of breeding piping plovers by raising awareness. It will also reduce predation by reducing the number of feral cats, domestic cats and dogs and the number of people who feed gulls on the beach.
- Reducing human disturbance will increase productivity and survivorship among piping plovers by reducing the amount of time incubating birds are disrupted from the nests and reducing the occurrence of nest abandonment.
- Reducing the number of predators on beaches will reduce the risk of eggs and chicks being stepped on by humans and their pets and reduce the number of chicks that are lost to predation.
- Education and outreach should be targeted to town officials, members of the local communities, and day visitors to beaches to raise awareness, understanding, and support.
- Education and outreach should be conducted year round. Education programs with the local schools and meetings with town officials should be conducted in the off-season to raise awareness and support among the community. Outreach to residents who live directly along the beaches should be conducted just before the start of each breeding season to raise awareness. Education and outreach to day visitors should be conducted during the summer months when plovers are breeding and most people visit beaches.
- Education and outreach efforts will consist of direct contact and involvement with members of the local communities and those who use New Hampshire beaches for recreation. Public attitudes towards piping plovers will be learned, and this information will be used to guide management activities. Furthermore, education and outreach efforts should lead to greater community involvement in the management of piping plovers and their breeding areas.

(C) Conservation Performance Objective
To support breeding piping plovers by increasing community awareness of, and involvement in, the protection and management of this endangered species that occurs in their back yard.

(D) Performance Monitoring
Observe use of beaches for a decrease in human and animal activity during breeding plover breeding season. Increase the number of people from local areas volunteering to monitor plovers.

(E) Ecological Response Objective
The desired ecological response is greater productivity for each breeding season.

(F) Response Monitoring

- Observe and record the number of volunteers from the local communities for an increase in involvement.
- Observe use of beaches and plover breeding areas for a decrease in the number of domestic pets observed.
- Monitor breeding piping plovers and recording productivity for increases in productivity.

(G) Implementation

- Continue posting signs along areas closed for piping plover breeding areas.
- Create and install educational displays at all main beach entrances.
- Give an informative presentation to town officials, local conservation commissions, community groups involved in beach management, local police departments, state parks personnel and feral cat feeding program coordinators.
- Create mini-presentations for day visitors at beaches, including a guided walk to observe piping plovers.
- Create and distribute an informational packet mailing to all residents who live along piping plover breeding areas.
- Create an educational program to be used in local schools and organize student involvement in monitoring and management on the beaches.
- Recruit, train, and maintain piping plover volunteer monitors.

(H) Feasibility
NHFG has been constrained by limited funds for plover monitoring and management and the creation of education and outreach programs. To date, funding has been used to hire one temporary seasonal piping plover monitor. This position involves carrying out the logistics of monitoring plovers, managing breeding areas, coordinating volunteer efforts and coordinating beach management activities between local, town, state and federal groups.

4.1.3 Institute temporary closures of piping plover breeding areas, Restoration and Management, Habitat Protection, Regulation and Policy.

(A) Human disturbance, Motorized vehicles and Predation

(B) Justification

- Closing piping plover breeding areas will eliminate all forms of human disturbance and predation by domestic dogs and will eliminate all use of motorized vehicles in the breeding areas, thus fostering a more productive breeding environment.
- Eliminating human disturbance and motorized vehicles and reducing the number of predators present in the breeding areas will have a direct positive impact on the survivorship and productivity of breeding piping plovers.
- Areas targeted for closure during the breeding season should include the NHFG property on the south side of the Seabrook-Hampton Bridge on Seabrook Harbor and the southernmost dune at the south end of Hampton Beach State Park near the jetty. Areas of Seabrook Town Beach should be considered as well.
- Closures of piping plover breeding areas should be in place between 15 March and 31 August. Areas may be reopened sooner than 31 August, as determined by observations of fledging by the piping plover monitor.
- Areas designated for closure during the breeding season will be monitored. If no birds use 1 or more of the designated areas, then those areas may be opened.

(C) Conservation Performance Objective
Eliminate disturbance by humans, their pets and motorized vehicles to allow this federally endangered and state threatened species space to perform courtship, nest and raise its young through complete closures of designated piping plover breeding areas on an annual basis

(D) Performance Monitoring
Monitoring will continue as outlined in the USFWS guidelines in both areas designated as closed for plover breeding and areas left open to human uses where piping plovers breed.

(E) Ecological Response Objective
The desired ecological response to closure of piping plover breeding areas is the maintenance of between 1.24 and 1.50 chicks fledged per pair each year. When this is achieved, New Hampshire will be contributing to the population of 2,000 breeding pairs along the Atlantic Coast , as outlined in the USFWS revised recovery plan.

(F) Response Monitoring
Areas closed for piping plover breeding will be monitored, as will areas left open to human use. Productivity will be compared between the two areas and calculated for the entire New Hampshire coast to determine whether productivity goals are being met and maintained.

(G) Implementation
NHFG, together with the USFWS, New Hampshire Audubon and other conservation organizations should decide on a plan of action for habitat restoration at the New Hampshire Fish and Game owned land on Seabrook Harbor. This coalition should begin to identify steps and strategies to work with other state agencies (i.e. Division of Resource and Economic Development – State Parks Department) and town officials to determine what actions need to be taken to institute temporary closures of piping plover breeding areas on State and Town owned lands.

(H) Feasibility
NHFG-owned land on Seabrook Harbor is the most feasible area for closure. However, this area requires habitat restoration work to make it suitable breeding habitat and therefore would not be the most appropriate for immediate consideration. Closure of the southernmost section of Hampton Beach State Park is the most appropriate area for immediate consideration because it is state-owned land that has supported breeding piping plovers consistently since 1997. This area also would be appropriate because of its minimum impact on human recreational uses. Closure of the breeding areas at Seabrook beach may be appropriate because these areas have supported breeding piping plovers since 1997. However, these areas will be more difficult to close because of their proximity to towns and the potential negative repercussions from disgruntled beach-goers.

4.1.4 Institute predator control protocol, Regulation and Policy

(A) Predation

(B) Justification
- Instituting a predator management protocol will enable action to be taken during the breeding season to control predators in piping plover breeding areas.
- Controlling predators in piping plover breeding areas will help to reduce the number of eggs, chicks and adults lost to predation and will increase productivity.
- Predator control should be instituted in piping plover breeding areas.
- Predator control should be conducted year round. Removal of predators from the breeding areas prior to and throughout the breeding season are crucial to plover nesting success.
- Predator control will only be carried out if evidence of predators is observed in the breeding areas and control will be targeted to the areas where predators are present.

(C) Conservation Performance Objective
The objective of instituting predator control protocol is to increase productivity among breeding piping plovers.

(D) Performance Monitoring
Monitoring of breeding piping plovers and management of breeding areas will continue as outlined in the USFWS Atlantic Coast Piping Plover Population Revised Recovery Plan.

(E) Ecological Response Objective
Reduce the number of eggs, chicks and adults lost to predation and observe an increase in New Hampshire's piping plover productivity each breeding season.

(F) Response Monitoring
Piping plovers and their breeding areas will con-

tinue to be monitored. The number and frequency of predators and the number of eggs, chicks, and adults lost to predation will continue to be observed and recorded. Piping plover productivity will continue to be determined each breeding season.

(G) Implementation
NHFGt must take action immediately to implement the most appropriate predator control in piping plover breeding areas. Options to consider include acquiring funding to provide for animal control in piping plover breeding areas, acquiring funding to hire a Departmental part time animal control person, contracting with a private wildlife control operator, or entering into an agreement with the U.S. Department of Agriculture, Wildlife Services.

(H) Feasibility
On town-owned lands, predator management has been the responsibility of local police departments' animal control officers and has been conducted as requested by the piping plover monitor. However, due to lack of funding, equipment, personnel, and animal control requests, local police departments do not effectively control predators in piping plover breeding areas. On state-owned lands where piping plovers nest, no predator control has taken place.

Despite these shortcomings, NHFG has the authority and the connections with USDA Wildlife Services to enter into agreements for instituting predator control in piping plover breeding areas. Although Wildlife Services has the personnel, the equipment, and the expertise to carry out effective predator control in piping plover breeding areas, controversy among local community members has kept New Hampshire Fish and Game from entering into any agreement with Wildlife Services.

4.1.5 Manage motorized vehicle use, Habitat Protection, Regulation and Policy.

(A) Motorized vehicles

(B) Justification

- Managing motorized vehicle use in piping plover breeding areas will reduce mortality of eggs, chicks and adults during the breeding season and will help to protect piping plover breeding habitat year round.
- Successful management of motorized vehicle use will be evident in the survivorship and productivity of breeding piping plovers and in the overall health of the coastal sand dune habitat.
- Management of motorized vehicles should be targeted at coastal sand dune systems, including known and potential piping plover breeding areas.
- Motorized vehicles should continue to be managed as outlined in the USFWS Atlantic Coast Piping Plover Population Revised Recovery Plan.
- Daily monitoring of breeding piping plovers and management of breeding areas, combined with partnerships between town, state and federal officials in beach management will allow for adjustments to be made to vehicle use on beaches as necessary.

(C) Conservation Performance Objective
The objective of managing motorized vehicles is to increase productivity of breeding piping plovers along the New Hampshire coast.

(D) Performance Monitoring
Observation of motorized vehicles use will continue as part of the daily monitoring of breeding piping plovers and the management of breeding areas. NHFG will continue to work with town, state and federal officials involved in beach management activities to coordinate motorized vehicle use on beaches and in piping plover breeding areas.

(E) Ecological Response Objective
Increase piping plover productivity and protect breeding habitat areas.

(F) Response Monitoring
Daily observation and monitoring of breeding piping plovers and their habitat will result in documented occurrences of motorized vehicle use in breeding areas. NHFG will continue to coordinate beach management activities in piping plover breeding areas between town, state, and federal officials.

(G) Implementation
NHFG should continue to carry out monitoring and management as outlined in the USFWS Atlantic Coast Piping Plover Population Revised Recovery Plan. In addition, NHFG should revise existing

wording on lobster regulations. Currently, licensed lobstermen are allowed to drive on New Hampshire beaches to look for and retrieve lobster traps that wash ashore after storms. This regulation should be reworded to enact a restriction on all vehicle use, including licensed lobstermen, during the piping plover breeding season.

(H) Feasibility:
NHFG has been working since 1997 with all public employees and officials in order to manage motorized vehicle use in piping plover breeding areas. These efforts have been carried out under the USFWS guidelines and should continue. NHFG has the authority, the staff and the expertise to change wording of regulations affecting fish and wildlife management in the state. Action should be taken as soon as possible to make the necessary revision permitting licensed lobstermen to drive on beaches.

4.2 Conservation Action Research
Due to growing human populations and increasing recreation and development pressures, effective management of piping plovers and their breeding areas is vital to their existence. Research should be conducted to consider different approaches for managing piping plover breeding areas.

Element 5: References

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5.2 Data Sources:

Table 1. USFWS. Piping Plover Atlantic Coast Population, Annual Status Report 2002-2003 accessed 3.21.05 http://www.fws.gov/northeast/pipingplover/status/index.html

Element 6: List of Figures

STATE/REGION	PAIRS															
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Goal
Maine	16	17	18	24	32	35	40	60	47	60	56	50	55	65	61	
New Hampshire									5	5	6	6	7	7	7	
Massachusetts[e]	137	140	160	213	289	352	441	454	483	495	501	496	495	538	511	
Rhode Island	19	28	26	20	31	32	40	50	51	46	39	49	52	58	71	
Connecticut	34	43	36	40	24	30	31	26	26	21	22	22	32	31	37	
NEW ENGLAND	206	228	240	297	376	449	552	590	612	627	624	623	641	699	687	625
New York[d]	191	197	191	187	193	209	249	256	256	245	243	289	309	369	386	
New Jersey	128	126	126	134	127	124	132	127	115	93	107	112	122	138	144	
NY-NJ REGION	319	323	317	321	320	333	381	383	371	338	350	401	431	507	530	575
Delaware	3	6	5	2	2	4	5	6	4	6	4	3	6	6	6	
Maryland	20	14	17	24	19	32	44	61	60	56	58	60	60	60	59	
Virginia	121	125	131	97	106	96	118	87	88	95	89	96	119	120	114	
North Carolina	55	55	40	49	53	54	50	35	52	46	31	24	23	23	24	
South Carolina		1	1		1			0					0			
SOUTHERN REGION	199	201	194	172	181	186	217	189	204	203	182	183	208	209	203	400
U.S. TOTAL	724	752	751	790	877	968	1150	1162	1187	1168	1156	1207	1280	1415	1420	1600
ATLANTIC CANADA	233	229	234	234	234	181	208	186	197	212	240	231	245	275	256	400
ATLANTIC COAST	957	981	985	1024	1111	1149	1358	1348	1384	1380	1396	1438	1525	1690	1676	2000

Table 1. Summary of Atlantic Coast Piping Plover Population Estimates, 1989 to 2003

SPECIES PROFILE

Purple Finch

Caprodacus purpureus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S5
Author: John J. Kanter, NHFG

Element 1: Distribution and Habitat

1.1 Habitat Description

Purple finch nest in cool coniferous forests and a variety of other cover types (Wooton 1996) where conifers are present. During winter, purple finch are likely to be distributed by food resources rather than habitat structure or vegetative composition (Wooton 1996). In a New York study area, higher breeding densities were strongly correlated with the ratio of forest edge to forest area and with the density of understory vegetation (Keller 1990, as cited in Wooton 1996). Purple finch also nest in orchards, conifer plantations, and suburbs. Purple finch ability to adapt to these anthropogenic habitats has likely expanded its range.

1.2 Justification

Purple finch populations have declined 1.7% annually ($p<0.05$) throughout its range from 1966 to 2003 (Sauer et al. 2004). In the Atlantic Northern Forest (Bird Conservation Region 14), a conservation-planning unit that includes most of New Hampshire, the 2.43% ($p<0.001$) annual rate of decline has been more severe. Analysis of annual Christmas Bird Count data demonstrates a similar declining trend based on purple finch observation rates in primary wintering range (Bolgiano 2004).

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act of 1918
- Bird Conservation Region (BCR) 14 high priority species

1.4 Population and Habitat Distribution

BCR 14 supports 11.4% of the purple finch breeding population and some of the highest densities known for the species. The purple finch is found in all 3 of the state's ecoregion sections and was documented in 172 out of 179 priority breeding bird atlas survey blocks (McDermott 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

N/A

1.7 Sources of Information

Primary sources of information included peer-reviewed literature, Breeding Bird Survey Database, New Hampshire's Breeding Bird Atlas, and expert consultation.

1.8 Extent and Quality of Data

The annual breeding bird survey, New Hampshire's Breeding Bird Atlas, and numerous local surveys (e.g., White Mountain National Forest Monitoring) provide extensive information on purple finch distribution and abundance. Purple finch habitat associations are poorly described.

1.9 Distribution Research

- Continue annual breeding bird survey routes
- Update New Hampshire's Breeding Bird atlas at 20-year intervals

Element 2: Species/Habitat Condition

2.1 Scale

New Hampshire's 3 ecoregion sections are appropriate for scale because conifer composition, especially spruce fir, differs among them: White Mountains = 120,344 ha, Vermont/New Hampshire uplands = 44,441 ha, and Lower New England = 7,136 ha.

2.2 Relative Health of Populations

Purple finch densities, represented by average number per breeding bird survey route (1966 to 2003), are highest in the White Mountain Section, intermediate in Vermont /New Hampshire Uplands, and lowest in the Lower New England Section (Sauer et al. 2004)

2.3 Population Management Status

No population management is conducted for purple finch.

2.4 Relative Quality of Habitat Patches

The White Mountain Section's greater composition of conifers, especially spruce and fir, provides habitat that likely supports New Hampshire's highest purple finch densities. The Vermont-New Hampshire Upland has the next highest composition of spruce-fir habitat and is intermediate in its purple finch habitat quality. The Lower New England Section's combination of urbanization and lack of spruce and fir provides the lowest habitat quality.

2.5 Habitat Patch Protection Status

Fifty percent of the White Mountain section is in conservation ownership.

2.6 Habitat Management Status

Because large areas of the White Mountain section are in public ownership, management opportunities are significant. Purple finch habitat associations need to be more clearly defined in order to prescribe forest management practices that benefit this species.

2.7 Sources of Information

Peer-reviewed literature, Breeding Bird Survey Data, and New Hampshire Fish and Game GIS

2.8 Extent and Quality of Data

The loss of breeding spruce fir habitat from 1970 to 1983 due to Eastern budworm outbreak (Bolgiano 2004) and interspecific competition with house finch (*Caprodacus mexicanus*) that was introduced to eastern North America in 1930 (Wooton 1996), are offered as explanations for the purple finch's regional decline. Both hypotheses rely on correlation of these events with purple finch population declines without providing evidence of any direct causes.

Purple finch numbers reported for the Christmas Bird Count were twice as high during the 1970 to 1983 outbreak of Eastern spruce budworm (*Choristoneura fumiferana*) than during the preceding and subsequent 20-year periods (Bolgiano 2004). Purple finch populations may have risen as nest productivity increased from this abundant food source. Extensive logging operations to salvage wood damaged by budworm subsequently led to modification of millions of hectares of prime breeding habitat. The purple finch population in the region declined in response to the combined loss of food and habitat that resulted from the budworm outbreak.

Wooton (1996) offers an alternative explanation that competition with the house finch is responsible for the decline. The decline in purple finch in eastern North America correlates with the introduction and establishment of the house finch. Nevertheless, competition, hybridization, or other interspecific perturbations are not well documented.

2.9 Condition Assessment Research

Research is needed to identify factors leading to purple finch declines. In addition, research that clearly describes habitat associations of purple finch in Atlantic Northern Forests will better inform foresters and landowners about habitat enhancement practices. Research that links small-scale habitat features with large-scale land cover data sets is needed to predict how population changes are affected by forestry and eastern budworm damage.

Element 5: References

5.1 Literature

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SPECIES PROFILE

Purple Martin

Progne subis

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S1
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

In New Hampshire, purple martin (hereafter called martins) colonies are located in open areas with a relatively unobstructed view of the horizon. Such areas include golf courses, lakeshore residential areas, open fields, and low-density residential areas. Many colonies are near water (lakes or rivers), although a water feature does not appear to be critical to the species. Martins prefer nest poles that are not vegetated at the base and that are within 100 feet of human habitation (presumably to avoid predation) (Purple Martin Conservation Association, Hill 1990).

1.2 Justification

Martins have been declining over most of their range in New England for at least 2 decades (Laughlin and Kibbe 1985, Zeranski and Baptist 1990, Veit and Petersen 1993, Hunt 2003). Breeding Bird Survey data indicate a range wide decline of 0.6% per year, with the decline concentrated in eastern North America (0.9% per year, Sauer et al. 2004). In the East, declines appear most dramatic in the northern United States and along the Gulf Coast.

Martin distribution within New Hampshire has contracted significantly over the last 50 years (figure 1). Whereas the Lakes Region and other areas of east-central New Hampshire have apparently always contained several colonies, other regions such as the Contoocook Valley and Western Highlands appear to have completely lost their colonies since broad surveys were first conducted in the late 1950s. Small colonies on the Seacoast (Great Bay and in Rye) barely survive, and were unoccupied in 2004 despite regular management and monitoring activity at both sites.

1.3 Protection and Regulatory Status

This species is protected at the federal level by the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs. In New Hampshire, it is protected by the New Hampshire Endangered Species Conservation Act (RSA 212).

1.4 Population and Habitat Distribution

Martins were recorded in New Hampshire in the late 1700s and sporadic records exist for the 1800s, but it was not until roughly the 1880s that consistent records were kept. In the early 1900s, martins were locally common over most of the lowlands in southern and central New Hampshire, with scattered populations in the Connecticut River Valley as far north as Colebrook and Lancaster (Allen 1903, Wright 1911).

Forbush (1929) reported a significant die-off due to cold weather in June 1903, with a smaller die-off in the summer of 1914. In the aftermath of these die-offs, the first statewide colony survey in 1920-21 found only 17 colonies in 10 towns, with half of the colonies in southeastern New Hampshire (Hebert 1960, see Hunt 2003).

A second major decline occurred in June 1959, when cold wet weather in mid-June caused martins to desert many colonies, and even resulted in some adult mortality (Hebert 1959). A statewide survey was repeated in 1959-60 and found only five of the previous colonies still active; none of the southeastern colonies from 1920-21 were still active. However, several new colonies were located, resulting in a net increase to 22 colonies in 18 towns (Hebert 1960). Additional colonies reported during in the three years prior to this survey bring the total for the late 1950s up to at least 30 (Figure 1a).

The next statewide martin survey was the Breeding Bird Atlas surveys (1980-85). Martins were confirmed breeding in 17 atlas blocks and recorded as "probable" in five more. These blocks were distributed across 21 towns, primarily in Carroll, Belknap, and Merrimack counties (Figure 1b). In addition, NHBR data from this period show five additional colonies apparently not reported to the Atlas.

A dramatic decline beginning in the mid-1980s (figure 2) may be at least partially attributable to the cessation of intensive surveys, although other data seem to indicate a real decline. Data from the Breeding Bird Survey (BBS) indicate a drop in martin numbers over most of the eastern United States in 1983 (Sauer et al. 2003). Martins disappeared from the Hopkinton BBS route after 1985.

Starting in the late 1980s, almost all the available data on purple martin distribution in the state come from NHBR. There are consistent records for only 7 sites, and single-year records for 2-4 more. Three additional historic sites were reported as active to the Purple Martin Conservation Association (PMCA), but none more recently than 1987. Martins were also reported to the PMCA at 4 additional locations, but none of these was confirmed.

1.5 Town Distribution Map

See Figure 1.

1.6 Habitat Map

N/A

1.7 Sources of Information

Information on purple martin colony locations was obtained from New Hampshire Bird Records, Foss (1994), the PMCA, and local bird publications. Regional information was collected from state bird publications and the Breeding Bird Survey.

1.8 Extent and Quality of Data

When martin surveys were promoted and coordinated at the statewide level (1959 to 1960, early 1980s, and early 2000s), data on martin distribution in New Hampshire were probably very accurate. The species' colonies are highly visible and the species is easily identified. However, the local nature of most colonies makes them less likely to be discovered between surveys. For example, 3 of the 10 colonies active between 2002 and 2004 were previously undocumented. Ironically, martins' penchant for nesting in residential areas and on golf courses probably decreases the chances of colonies being sighted, because lay birders do not frequent these areas.

1.9 Distribution Research

Much is known about the distribution of the purple martin in New Hampshire. Where historic town records exist, however, the exact habitat should be identified for future restoration projects.

Element 2: Species Condition

2.1 Scale

Each colony is treated as a conservation-planning unit, even though all colonies inhabit similar artificial housing. Because maintenance and housing conditions vary from place to place, this distinction between colonies is intuitive. Nevertheless, the transient nature of artificial habitat means that historic comparisons must be discarded.

2.2 Relative Health of Populations

In the column "Current Size" in table 1, the current size (2002-2004 average) of the colony is given in number of pairs. The column "Historic Size" reflects the general status of the colony during the 1980s. In general, these data indicate that most colonies are smaller than during the 1980s, which corroborates the statewide population decline discussed in section 1.2.

2.3 Population Management Status

In table 1, colony management is rated as one of the following:

- Poor: the nest boxes are not known to be cleaned annually, and competitors are not discouraged or excluded.
- Fair: the nest boxes are sometimes cleaned (or cleaning has been less frequent in recent years)
- Good: the nest boxes are regularly cleaned and monitored, though competitors are not usually controlled
- Excellent: the nest boxes are regularly cleaned and competitors regularly discouraged. It should be noted that the 2 "excellent" only achieved this rating in 2004, when martins did not use either site. Assuming management continues in the absence of martins, these colonies would retain this rank even if no birds were present.

2.4 Relative Quality of Habitat Patches

Given that colonies are effectively the same as habitat patches for this species, see column "Colony Management" in table 1. The column "Housing Availability" can supplement this, which is the current number of compartments in the available martin housing at a given colony. Data on colony size, potential colony size, and management status have been combined into the final column, "Colony Potential." Colony Potential reflects the possibility of growth in a given colony given existing conditions and historic occupancy levels, as follows:

- Low Growth: small or recently abandoned colony that may reestablish itself, given that management of "good" or better is in place.
- Stability: larger colonies that have maintained a constant population for several years. There is potential for increase if management is elevated to "excellent."
- Uncertain: colonies with limited data, or where declines appear to have occurred in recent years. Declines may be reversed with improved management.

2.5 Habitat Patch Protection Status

All recently active martin colonies are under private ownership.

2.6 Habitat Management Status

See section 2.3.

2.7 Sources of Information

Information on management and condition of active or recently active colonies was obtained through a combination of site visits and discussions with colony owners. Trends in colony size were obtained from NHBR and current site monitoring activity.

2.8 Extent and Quality of Data

The assessment of colony potential described above is necessarily brief. Although much is known about trends in colony size and distribution in the state, little is known about causal factors (see element 3). And although it is known that management can result in colony growth (Brown 1981, Hill 1990), it is not clear how effective these techniques may be in New Hampshire, where there is a limited source of new recruits into the population.

2.9 Condition Assessment Research

Much research has already been conducted to determine the best conditions for purple martin reproduction (Brown 1981; Hill 1990, 1991, 1999; Kostka 1998, 2000), so there is little need for a research program in New Hampshire.

Element 5: References

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5.2 Data Sources:

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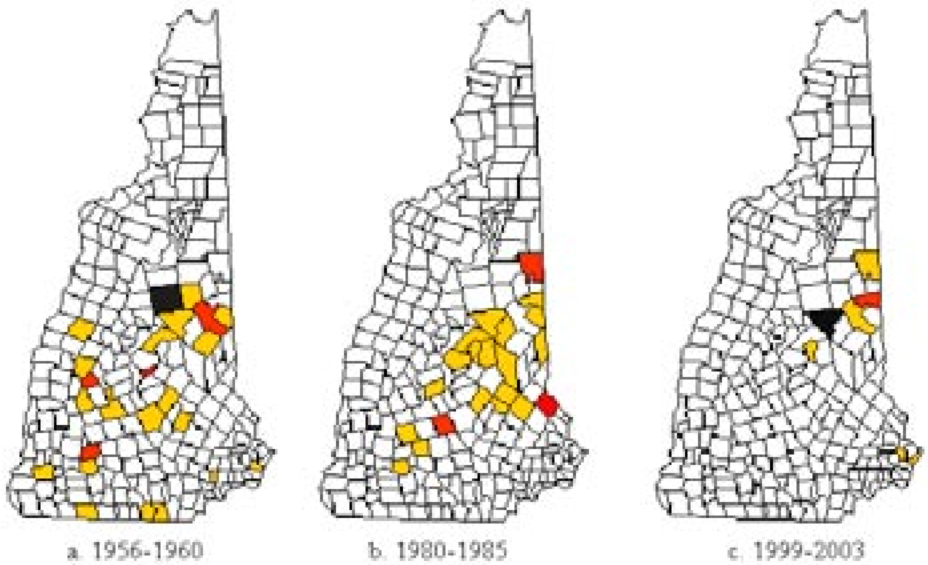
PMCA. Purple Martin Conservation Association – Colony Registration Program, Edinboro, PA.

Element 6: List of Figures

Figure 1. Distribution of Purple martin colonies in New Hampshire for three five-year periods: a. late 1950s (statewide Audubon surveys), b. early 1980s (Breeding Bird Atlas), and c. early 2000s (current monitoring program). Towns shaded to indicate number of colonies: yellow = one, red = two, black = three.

Figure 2. Number of Purple martin colonies in New Hampshire, 1951-2003. Each point represents the total number of colonies reported during the five year period.

Table 1. Overview of purple martin colonies in New Hampshire, 2000 to present. Current size, historic size, and housing availability are expressed in number of pairs. Terms used to describe colony management are defined in section 2.3. Colony potential is based on a combination of population trend and management status for a given colony (see section 2.4).



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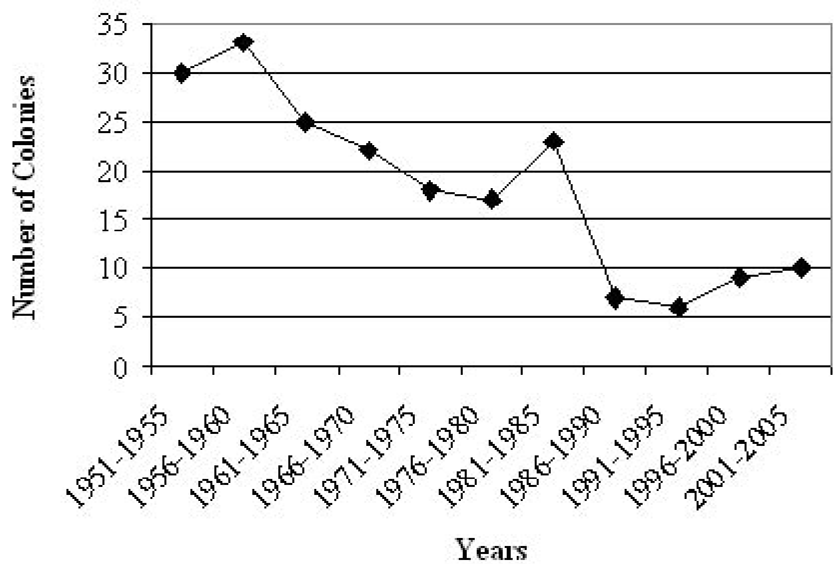

Unit #	Unit Name	Current Size	Historic Size	Colony Management	Housing Availability	Colony Potential
1	Fun Spot	23	10+	Good	82	Stability
2	Conway	22	40	Fair	96	Stability
3	Windward Harbor	9	10	Good	12	Low Growth
4	Lees Mill	8	10	Poor	23	Uncertain
5	Indian Mound	3	Not known	Unknown	24	Uncertain
6	Hodge Farm	3	30+	Good	36	Low growth
7	Totem Pole	2	10+	Fair	48	Uncertain
8	Portsmouth Country Club	2	3	Excellent	30	Low growth
9	Hemlock Point	1	Not known	Good	27	Low growth
10	Wentworth Golf Course	1	Not known	Excellent	12	Low growth

Table 1. Overview of purple martin colonies in New Hampshire, 2000 to present. Current size, historic size, and housing availability are expressed in number of pairs. Terms used to describe colony management are defined in section 2.3. Colony potential is based on a combination of population trend and management status for a given colony (see section 2.4).

SPECIES PROFILE

Purple Sandpiper

Calidris maritima

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: SNA
Author: Alina, J. Pyzikiewicz, NHFG

Element 1: Distribution and Habitat

1.1 Habitat Description

Purple sandpipers breed in tundra and rocky shores and overwinter on coastal islands (Payne and Pierce 2002). Breeding areas include mossy areas near the shoreline and coastal barren flats with abundant insects and seeds (Payne and Pierce 2002). Wintering grounds include rocky coasts and jetties and coastal islands where crustaceans, mollusks, and other invertebrates are plentiful (Payne and Pierce 2002).

1.2 Justification

The North Atlantic coast is one of the heaviest populated areas in the United States and is undergoing rapid development. The purple sandpiper uses New Hampshire's rocky shores and islands as wintering grounds.

1.3 Protection and Regulatory Status

The purple sandpiper is protected under the Migratory Bird Act and various non-government coastal shorebird programs (Bird Conservation Regional plans, The United States Shorebird Conservation Plan, Waterbird Conservation for the Americas).

1.4 Population and Habitat Distribution

In North America, purple sandpipers breed primarily on islands in the Canadian Arctic and overwinter on the coast from Quebec to South Carolina (Payne and Pierce 2002). In New Hampshire, the purple sandpiper winters along the rocky coastlines of Rye, Hampton, and Seabrook, and on the Isles of Shoals (New Hampshire Bird Records (NHBR)). It forages off the mainland coast from October to April, and on the Isles of Shoals as late as August (NHBR). The heaviest concentrations of wintering purple sandpipers in New Hampshire have been observed at Rye Harbor State Park, the rocks at Hampton Harbor, and the Isles of Shoals (NHBR). Population sizes are unknown because access to these areas is limited (Morrison et al. 2001). The United States Shorebird Conservation Plan (2000) estimates populations of wintering purple sandpipers in North America to be around 15,000.

1.5 Town Distribution Map

Not comopleted for this species.

1.6 Habitat Map

Not addressed for this species.

1.7 Sources of Information

Birds of North America, NHBR, and the United States Shorebird Conservation plan.

1.8 Extent and Quality of Data

Little is known about the status of the purple sandpiper in New Hampshire. Published information regarding North American breeding and wintering grounds is minimal, with most research taking place outside North America (Payne and Pierce 2002).

1.9 Distribution Research

- Identify and monitor important wintering areas

- Conduct surveys to estimate wintering population size
- Determine factors limiting population size and habitat use
- Coordinate research and monitoring activities with other countries that support purple sandpipers

Element 4: Conservation Actions

See Coastal Islands Habitat Profile.

Element 5: References

5.1 Literature

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5.2 Data Sources

New Hampshire Bird Records. New Hampshire Audubon, Concord, New Hampshire, USA.

SPECIES PROFILE

Red Shouldered Hawk

Buteo lineatus

Federal Listing: Not listed
State Listing: Special Concern
Global Rank: G5
State Rank: S3
Author: Carol R. Foss, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Red shouldered hawks in the northeastern portion of their range typically inhabit large contiguous blocks of moist and mature deciduous and mixed forests. They especially prefer bottomland and riparian forests and forested wetlands and will use suburban woodlots if there is adequate foraging habitat nearby (Crocoll 1994).

1.2 Justification

The northeastern red shouldered hawk population experienced a substantial decline during the 1960s (Henny 1972, Palmer 1988). This species was listed as Threatened in New Hampshire between 1980 and 1986, was on the American Birds Blue List throughout its range between 1972 and 1986 (Tate 1986), and was considered a migratory non-game bird of management concern in the northeastern United States in 1987 (Peterson and Crocoll 1992). Population increases led to reduced levels of concern and subsequent downlistings. According to analyses of Breeding Bird Survey data, red shouldered hawk populations are increasing regionally (Sauer et al. 2004).

However, increasing levels of forest fragmentation and recreational activity may justify monitoring, particularly in southern New Hampshire. Clearing of large forest blocks has been implicated in population declines (Brown 1971, Woodrey 1986, Hands et al. 1989, Preston et al. 1989, Peterson and Crocoll 1992), and forest fragmentation favors Great Horned Owls and Red-tailed Hawks over red shouldered hawks (Bednarz and Dinsmore 1981, 1982, Bryant 1986).

1.3 Protection and Regulatory Status

The Red-shouldered hawk is protected in the United States under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755) as amended by: Chapter 634; June 20, 1936; 49 Stat. 1556; P.L. 86-732; September 8, 1960; 74 Stat. 866; P.L. 90-578; October 17, 1968; 82 Stat. 1118; P.L. 91-135; December 5, 1969; 83 Stat. 282; P.L. 93-300; June 1, 1974; 88 Stat. 190; P.L. 95-616; November 8, 1978; 92 Stat. 3111; P.L. 99-645; November 10, 1986; 100 Stat. 3590 and P.L. 105-312; October 30, 1998; 112 Stat. 2956).

1.4 Population and Habitat Distribution

The New Hampshire population of red shouldered hawks is estimated at 1,400 to 1,600 individuals, based on a cursory examination of topographic maps. Maps were examined for location of potential home ranges based on presence of wetlands or bottomland forests on a town-by-town basis. The combined population estimate for BCRs 14 and 30 is 7,330 individuals (Hunt 2005). The range-wide population is estimated at 830,000 (Rich et al. 2004).

New Hampshire Endangered Species Program and NHBR documented 88 occupied red shouldered hawk territories in southern New Hampshire during the 1981 to 1989 breeding seasons: 41 in Merrimack County, 19 in Hillsborough County, and 28 in Rockingham County. Biologists conducting searches and broadcast surveys at 57 of these sites in 1990, detected red shouldered hawks at 25 of the 57 sites, and rated habitat at 44 as suitable, 11 as marginal, and 2 as no longer suitable (NHA, unpublished data).

Red shouldered hawks are more common in the Sebago-Ossipee Hills, Coastal Plain, and southern New Hampshire Uplands subsections than elsewhere in the state (Foss 1994), where mountainous terrain limits the distribution of suitable wetlands.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

The information in this account is based on review of available literature and analysis of data in the NHBR Database from 1991 to 2004.

1.8 Extent and Quality of Data

Searches for red shouldered hawks were conducted under the auspices of the New Hampshire Endangered Species Program during the 1980 and 1981 breeding seasons. Biologists used broadcast surveys to determine occupancy of 57 previously documented territories in 1990. Additional data were obtained during fieldwork for the New Hampshire Breeding Bird Atlas (1981 to 1986) and by serendipitous observations. The absence of documented territories in Sullivan County is more likely the result of a lack of observers than of the absence of red shouldered hawks.

1.9 Distribution Research

The relatively specific habitat needs of this species (mature forest and extensive wetlands) enable identification of potential territory sites from topographic maps. Field surveys of identified potential sites in the rapidly developing southeastern counties would provide an important baseline against which to measure future population change. In addition, field efforts in Sullivan County would clarify the species' distribution in New Hampshire.

Element 2: Species/Habitat Condition

2.1 Scale

Conservation of red shouldered hawks is best addressed at the ecoregional scale. New Hampshire Endangered Species Program data from the 1980 and 1981 field seasons and New Hampshire Breeding Bird Atlas data suggest that red shouldered hawks occur at highest densities in the Southern New England Coastal Hills and Plain Ecoregion. Suitable habitat and documented territories are scarce and widely scattered in the White Mountains and Vermont-New Hampshire Uplands ecoregions. County analyses of potential habitat confirm this assessment (see table 1). Field surveys have high territory densities in Kensington/South Hampton (0.35/sq. mi), Andover (0.15/sq. mi), Dunbarton (0.13/sq. mi), and Canterbury (0.11/sq. mi).

2.2 Relative Health of Populations

Insufficient data exist to assess recent population trends for New Hampshire. Breeding Bird Survey data suggest that red shouldered hawk populations are increasing regionally (Sauer et al. 2004).

2.3 Population Management Status

No population management efforts are under way, and there is no evidence that such efforts are needed.

2.4 Relative Quality of Habitat Patches

Quality of habitat patches varies from sites in large blocks of unfragmented forest with relatively pristine wetlands to sites in highly fragmented forest with wetlands degraded by stormwater runoff from roads and other impervious surfaces. Two of the counties with the highest densities of potential territories experienced New Hampshire's most rapid development from 1990 to 1997; Hillsborough and Rockingham counties each received 27% of the State's new housing units during that period (Sundquist and Stevens 1999).

2.5 Habitat Patch Protection Status

Unknown.

2.6 Habitat Management Status

No active habitat management is currently underway.

2.7 Sources of Information

Cited literature, evaluation and analysis of available data, and consultation with colleagues.

2.8 Extent and Quality of Data

Searches for red shouldered hawks were conducted under the auspices of the New Hampshire Endangered Species Program during the 1980 and 1981 breeding seasons. Biologists used broadcast surveys to determine occupancy of 57 previously documented territories in 1990. Additional data were obtained during fieldwork for the New Hampshire Breeding Bird Atlas (1981 to 1986) and by serendipitous observations. Potential territories were identified roughly from the New Hampshire Atlas and Gazetteer (DeLorme 2002). There has been no recent field survey to determine habitat quality of historical and potential territories.

2.9 Condition Assessment Research

Priority research for this species is the GIS analysis of fragmentation and development metrics for potential habitat.

Element 3: Species and Habitat Threat Assessment

3.1.1. Development (Fragmentation, Habitat Loss and Conversion)

(A) Exposure Pathway
Development and deforestation reduce availability of nesting sites and foraging areas. Remaining habitat exists in patches interspersed among other land uses, and such landscape mosaics provide suitable habitat for Great Horned Owls and Red-tailed Hawks. The relative contributions of reduced foraging area, aggressive interaction, predation, and competition to abandonment of fragmented sites are unknown.

(B) Evidence
Great horned owls are known to prey on red shouldered hawk nestlings (Huey 1913, Wiley 1975, Portnoy and Dodge) and to nest in former red shouldered hawk nests (Palmer 1988). Habitat alteration (e.g., removal of trees) has preceded known cases of red-tailed hawks replacing red shouldered hawks (Palmer 1988). When habitat remains unaltered, red shouldered hawks may occupy specific territories for many years (Bent 1937).

3.2 Sources of Information

Literature review.

3.3 Extent and Quality of Data

Although there is no compelling reason to expect that New Hampshire red shouldered hawks should behave differently than those in other parts of the species' range, none of the primary research on which the threat discussion is based was conducted in northern New England.

3.4 Threat Assessment Research

- Where development in New Hampshire is high, field surveys and GIS analyses should be conducted to determine the nature of threats.
- Documenting territories and nest sites within tracts of protected land would provide insight into the long-term viability of the species in southern New Hampshire.

Element 4: Conservation Actions

4.1 Specific Conservation Action: Protect large unfragmented forest blocks with extensive wetland. Category: Habitat Protection

(A) Direct Threats Affected
Development (Fragmentation, Habitat Loss and Conversion)

(B) Justification
- Evidence cited above strongly suggests that

maintaining red shouldered hawk habitat enables local populations to persist over long periods.

- The threat posed by habitat loss and fragmentation must be confronted on the scale of individual home ranges. However, multiple home ranges in high-density areas should take precedence over single, isolated home ranges.
- Protective measures should be based on urgency of threats.
- The scope and nature of protective measures will reflect new information on red shouldered hawks.

(C) Conservation Performance Objective
Protect habitat for clusters of home ranges throughout the southern New England Coastal Hills and Plain Ecoregion.

(D) Performance Monitoring
Monitor number and location of protected habitat areas.

(E) Ecological Response Objective
Maintain local populations of successfully breeding pairs throughout the Southern New England Coastal Hills and Plain Ecoregion.

(F) Response Monitoring
Monitor protected home ranges with broadcast surveys and searches for nest sites.

(G) Implementation
See profile for unfragmented forest blocks of matrix forest.

(H) Feasibility
See profile for unfragmented forest blocks of matrix forest.

Element 5: References

5.1 Literature

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5.2 Data Sources

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Table 1. Estimated red shouldered hawk potential territories for New Hampshire counties.Figure 1. New Hampshire towns with red shouldered hawk observations reported to New Hampshire Bird Records during 1991-2004.

County	Area (sq. mi.)			Estimated potential home ranges	Estimated density
Belknap	467.6			35	0.07
Carroll	978.2			75	0.08
Cheshire	722			116	0.16
Coos	1884.7			34	0.02
Grafton	1746.2			69	0.04
Hillsborough	880.8			124	0.14
Merrimack	961.6			91 87	0.09
Rockingham	705.5			115	0.16
Strafford	378.5			55	0.15
Sullivan	548.7			27	0.05

Table 1. Estimated red shouldered hawk potential territories for New Hampshire counties.Figure 1. New Hampshire towns with red shouldered hawk observations reported to New Hampshire Bird Records during 1991-2004.

SPECIES PROFILE

Roseate Tern

Sterna dougallii

Federal Listing: Endangered
State Listing: Endangered
Global Rank: G4
State Rank: S1
Author: Diane L. De Luca, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Roseate terns nest on small rocky or sandy islands, barrier beaches, salt marshes, and rarely on the mainland (USFWS 1989, Kress and Hall 2004). Most colonies are close to shallow-water foraging areas with sandy bottoms, bars, or shoals (Gochfeld et al. 1998). In the Northeast, roseate terns nest within common tern colonies (Nisbet 1989, USFWS 1998). Within these mixed colonies, roseate terns usually select habitat with dense vegetation or the protection of rocks and driftwood (Burger and Gochfeld 1988). They will also use artificial nest sites (e.g., boxes and half-buried tires) (Spendelow 1982).

Roseate terns forage over shallow sandbars, shoals, inlets, or schools of predatory fish, often in mixed flocks with other terns (Safina 1990, Shealer and Burger 1993, 1995). Roseates feed on at least 15 species of small marine fish but prefer sand lance (*Ammodytes* spp.) (Gochfeld et al.1998, Kress and Hall 2004). Feeding studies at New Hampshire's Seavey Island have documented sand lance (*Ammodytes* spp.), white hake (*Urophycis tenius*), Atlantic herring (*Clupea harengus*), and American Pollock (*Pollachius virens*) as key forage species (NHA and NHFG unpublished data 2003-2004). Foraging distance is variable (300 m^2 to 30 km^2) and depends on local prey availability. Roseate terns will travel farther than common terns to feed (Gochfeld et al. 1998, Kress and Hall 2004).

1.2 Justification

Since records were first taken in 1870, the roseate tern has dwindled somewhat in the region (USFWS 1988). This population nested from Nova Scotia to Virginia in the late nineteenth century but has been lost from all south of Long Island's south shore. The roseate tern was listed under the Endangered Species Act in 1987. At the time of listing, there were approximately 3,000 pairs nesting on 21 islands (10 islands with over 10 pairs) in the Northeast. Since then, restoration efforts have had a limited effect; populations continue to fluctuate around 3,700 pairs between New York and Nova Scotia (Roseate Tern Recovery Team (RTRT) 2004). Currently, the estimated numbers of nesting pairs in this region remains 3,700 on 19 islands (10 islands with over 10 pairs). Trend data from the last ten years show a population decline of 10% in spite of continued management (RTRT minutes 2004).

There have been recent large declines in southern New England and Long Island. Most sites on Long Island's south shore have been lost, and a significant Long Island Sound colony is greatly reduced (USFWS 1998, Kress and Hall 2004). In contrast, the cold water Gulf of Maine roseate population has been steady during this period. The Seavey Island roseate tern colony grew from 1 pair in 2001 to 112 pairs in 2004 (NHFG and NHA unpublished data). Thus, it is important to evaluate these smaller, cold-water populations for their potential to aid in recovery goals. More than 85% of the entire northeastern population currently nests on 4 islands between Buzzard's Bay and Long Island, New York, leaving the entire population increasingly vulnerable. Preservation of populations adapted to variable climates is critical in a time of global climate change.

The concentration of roseate terns in several large colonies, due to predation and loss of nesting sites, is the primary threat to the species (USFWS Roseate Tern Recovery Plan). Expanding gull populations have taken over many of the offshore islands that once supported terns, and other islands have been lost to erosion. Roseates were forced to nest at inshore islands where the habitat quality was lower and the risk of predation from multiple predators was high.

In the northeastern United States, eggs, chicks and adults are eaten by 11 avian, 10 mammalian, 1 reptile, and 2 ant species (Nisbet 1989). Additional limiting factors may include inadequate foraging resources, competition for nest sites, contaminant impacts, imbalanced sex ratio, and insufficient funds to adequately protect existing colonies. Inclement weather may also harm northeastern roseate tern populations. Little is known about factors affecting the population on its wintering grounds (Gochfeld et al.1998). In managing for roseate terns the needs of other coastal island species including common tern, Arctic Tern, common eider, black guillemot and purple sandpiper are also addressed

1.3 Protection and Regulatory Status

The roseate tern is protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the taking of bird, nest, and eggs. The roseate tern is also protected under the United States Endangered Species Act of 1973 and was listed as an endangered species on 2 December 1987. In April 1985, the Canadian population of the roseate tern was designated as threatened by the Committee on the Status of Endangered Wildlife in Canada.

In New Hampshire, the roseate tern is listed as an endangered species and protected under RSA 212. Seavey Island, the only current nesting location for roseate terns in New Hampshire, is managed by NHFG. Seavey Island is posted as an endangered species breeding site and the public is restricted from 1 May to 1 September. Seavey Island is actively managed through the breeding season, and biologists are present at the colony from late April to August.

1.4 Population and Habitat Distribution

In New Hampshire, the only current nesting of roseate terns occurs at Seavey Island, Isles of Shoals. The island has been intensively managed for terns since 1997. One pair of roseate terns successfully nested on Seavey Island in 2001 and the population quickly grew to include 112 pairs in 2004. The Seavey Island colony represents approximately 3% of the entire northeastern population and close to 40% of the roseate terns breeding in the Gulf of Maine.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

The New Hampshire GRANIT System was used to identify coastal islands. Very small islands were grouped to the nearest adjacent neighboring islands. In total, 96 polygons were grouped into 48 islands, which in turn were clustered into 15 conservation units. Each conservation unit was then defined by parameters such as size, shoreline, development, distance from known and potential contaminant sources, and the distances to the nearest aquaculture operations, oil spill response staging areas, recreational fishing areas, marinas and public beaches. New Hampshire Department of Environmental Services provided the locations of known contamination sources, heliports, oil spill response staging areas, recreational fishing, marinas, and aquaculture facilities.

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG Seavey Island data, New Hampshire Bird Records data, Gulf of Maine Seabird Working Group (GOMSWG) and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

1.8 Extent and Quality of Data

Roseate terns have been closely monitored in the region for more than 20 years. The Seavey Island roseate tern population has been intensively studied since recolonization in 2001. In New Hampshire, a census is taken at all current and recently occupied tern-nesting sites during June. Censuses were taken at the Isles of Shoals in 1977, 1985, 1995, and one is planned for 2005.

In 2004, nesting habitat parameters were measured on Seavey Island to develop habitat and vegetation profiles. This study is part of a habitat management plan to enhance nesting opportunities. Roseate tern foraging habitat is largely unknown in New Hampshire. In 2004, a brief study suggested that some foraging occurs near Seavey Island, but critical foraging areas remain undocumented. Few data exist on staging areas for roseate terns before or after the breeding period, or on migration and wintering habitat.

1.9 Distribution Research

- Continue intensive monitoring of roseate terns on Seavey Island and characterize breeding habitat
- Evaluate other islands at the Isles of Shoals for suitable tern habitat, especially historic sites (Lunging and Duck Islands)
- Identify priority habitats and potential restoration sites
- Document significant foraging and staging areas
- Band Seavey Island roseate tern chicks with field-readable bands to provide information on recruitment and intercolony movement. Develop protocol to systematically re-sight banded birds and coordinate with other islands for data exchange. Understand movement patterns of the roseate tern within the Gulf of Maine using the marked known aged population. Evaluate annual interchange of birds between GOM and "warm water" group.
- Research migration routes
- Research winter habitat use and distribution

Element 2: Species/Habitat Condition

2.1 Scale

Fifteen conservation units have been identified for coastal islands. All 9 islands at the Isles of Shoals are recognized as separate units.

2.2 Relative Health of Populations

The only New Hampshire population of roseate terns occurs on Seavey Island, Isles of Shoals. This population has been intensively monitored since 2001 when the first pair nested; in 2004, 112 pairs nested (table 1). Productivity has averaged 0.93 chicks per pair between 2001 and 2004 (table 2). This remains below the northeastern average of more than 1.1 chicks per pair. Fewer than 1 chick per pair is considered low but can be seen in small or newly formed colonies (Nisbet 1989, Gochfeld et al. 1998).

Seavey Island is now 1 of 2 colonies in the cold waters of the Gulf of Maine that number over 100 pairs; the other is Eastern Egg Rock in Muscongus Bay, Maine, which had 110 pairs in 2004. Seavey Island and Eastern Egg Rock are now the fifth largest colonies in the Northeast.

Roseate terns have not nested on any other islands at the Isles of Shoals since the late 1940s. The last known breeding on Lunging Island was in 1944 (Borror and Holmes 1990). Anecdotal evidence from Duck Island describes tern breeding in the "thousands". Both Lunging and Duck Island are potential breeding habitat but support large herring and great black-backed gull colonies.

The potential for roseate tern recolonization outside the Isles of Shoals is low. Inshore tern colonies contend with predation, disturbance, and the attendant disruptions of nesting habitats. Few inshore islands have the dense vegetation or rocky outcrops that roseates prefer to nest in. In addition, roseates only nest in common tern colonies of significant size. The largest common tern colony outside of Seavey Island rarely supports more than 12 pairs.

The objective for recovery in this species is to increase the Northeast nesting population to a minimum of 5,000 pairs with at least 6 large colonies (over 200 pairs) with high productivity (at least 1.0 fledged young per pair). A secondary objective is to expand the number of roseate tern breeding colonies to 30 or more sites. At present, there are only 4 sites larger than 200 pairs, and they all experience fluctuating productivity. The concentration of nearly all the roseate (100%), Arctic (100%), and common turns (98%) at one site in New Hampshire puts tern populations at great risk.

2.3 Population Management Status

The Seavey Island roseate, common and Arctic tern colony is managed intensively. Biologists live on the island throughout the breeding season, controlling predators, monitoring colony productivity, and implementing public outreach. Visitation is restricted from 1 May to 1 September to minimize disturbance.

Managers encouraged roseate terns to recolonize Seavey Island by using tern attractants and controlling gull populations. Gull control at Seavey Island consisted of dogs (late April), pyrotechnics, regular circumnavigation of the island beginning 30 minutes before sunrise and continuing until 30 minutes after sunrise, and the placement of a large rock in any gull nest cups (NHA and NHFG unpublished reports 1997-2003). Tern attraction techniques included the placement of decoys in suitable habitat along with the broadcast of tern colony sounds (Kress 1983). Common terns nested at this site in the first year of restoration efforts (1997).

Gull predation continues, but is dealt with successfully. Resident tern biologists intervene throughout the breeding season, and specialist predatory gulls are removed from the island. During summer, tern biologists regulate visitation and guide educational visits from Shoals Marine Lab, Star Island, and various other conservation organizations. Lighthouse renovation is scheduled to begin in 2005, and coordination with tern project biologists, New Hampshire Parks and Recreation oversight staff, and construction personnel will be imperative to avoid any disturbance to the terns.

2.4 Relative Quality of Habitat Patches

Seavey Island provides the best habitat for roseate terns in New Hampshire. A survey was initiated in 2004 to develop habitat and vegetation profiles for roseate nest sites. This study will evaluate the capacity of the site to support more roseate tern nesting and to document habitat changes. The quality of foraging habitat and prey availability on Seavey Island is largely unknown.

Duck Island and Lunging Island still have good potential for tern nesting, though the presence of gulls makes colonization problematic. Smuttynose Island once supported one of the largest gull concentrations at the Isles of Shoals, and the presence of raccoons and gulls makes this site unsuitable for tern nesting. A large gull colony exists on Appledore Island, where a research station is operated from April to October. However, rats, muskrats, raccoons, and human disturbance make this island unsuitable for terns.

2.5 Habitat Patch Protection Status

Seavey Island was deeded to the State of New Hampshire after the White Island Light was automated in 1987. White and Seavey Islands have been managed by the Department of Resources and Economic Development (DRED) Parks and Recreation Division as part of Odiorne State Park since 1993. A Memorandum of Agreement on tern restoration exists between DRED – Parks Division and the NHFG. Seavey Island is managed by NHFG as an endangered species nesting area and is afforded both state and federal protection under endangered species law.

The Coastal Islands National Wildlife Refuge purchased Duck Island in July 2003. This island will be managed for its wildlife resources, protected as a seabird colony, posted for closure during the breeding season, and evaluated for habitat management and restoration (B. Benedict, USFWS, personal communication). Privately owned Lunging Island is not protected beyond current shoreline and wetland regulations. Smuttynose Island is privately owned but was protected in August of 2001 by a conservation easement held by the Coastal Islands National Wildlife Refuge. This conservation easement allows the refuge to manage the site for wildlife resources (B. Benedict, USFWS, personal communication). Islands in the Piscataqua River, and Great and Little Bays are not suitable for roseate terns because of their proximity to the mainland.

2.6 Habitat Management Status

Seavey Island is managed for terns through the NHFG and NHA Tern Restoration partnership. Restoration efforts from 1997 to 2004 have focused on intensive management to eliminate gull nesting and to control predation, and have allowed re-colonization by common terns.

There has been a shift in the Seavey Island vegetation from yarrow and seaside goldenrod to tall dense grasses. Although the height of the grass makes the habitat more suitable for roseate terns, the density can cause problems for movement of both adults and chicks as the season progresses. In 2005, approximately 100 feet of boardwalk were laid through the grassy area to give more structure and opening to the nesting habitat, and to allow biologists access to this part of the island.

Other islands identified in section 2.4 as having the potential for tern recolonization need to have baseline habitat assessments. If determined to be suitable for restoration efforts, a habitat restoration plan would need to be developed and implemented.

2.7 Sources of Information

Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG data, GOMSWG, and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

2.8 Extent and Quality of Data

Seavey Island has been monitored intensively since 1997. Census and productivity numbers have been determined since roseate terns began nesting in 2001. Chick provisioning data were collected in 2004. Baseline habitat data for roseate tern nesting sites were also collected in 2004. It will be important to expand on these data to determine the habitat parameters in preferred nesting areas.

2.9 Condition Assessment Research

Monitoring

- Continue intensive monitoring of roseate terns on Seavey Island
- Continue to monitor productivity. Use established methods as outlined by the Roseate Tern Recovery Plan to determine productivity on a yearly basis

Research and Assessment

- Characterize roseate tern breeding habitat on Seavey Island. Determine the habitat parameters in preferred nesting habitat. Evaluate the need for vegetation management to maintain and/or increase roseate habitat on Seavey Island.
- Conduct habitat assessments at the other historical Isles of Shoals islands
- Identify and characterize preferred foraging habitat/sites. Evaluate vulnerability of principal foraging sites to human related over-use issues.
- Assess available foraging resources by conducting foraging studies. Establish protocol to study the relationship of prey availability and productivity. Identify prey availability during the courtship and egg-laying stage to determine impacts on clutch size. Identify inter-annual and inter-colony variation in prey and the potential effects on productivity. Develop understanding of how foraging effort affects reproduction.
- Assess potential impacts of an oil spill near Seavey Island

Research and Survey

- Identify important staging areas for Gulf of Maine roseate terns and the proportion of the population aggregating at staging/roosting areas. Conduct staging area counts through re-sighting of banded GOM birds, and determine the proportion of the population aggregating at staging/roosting areas. Build baseline information of the use of staging sites by NH and ME roseate terns. Determine if pre-migratory staging areas are a vulnerable population bottleneck.
- Identification and habitat assessment of important wintering areas

Element 5: References

5.1 Literature

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SPECIES PROFILE

Ruffed Grouse

Bonasa umbellus

Federal Listing: Not listed
State Listing: Not listed
Global Ranking:
State Ranking:
Author: Julie Robinson, Jim Oehler, and Ellen Snyder, New Hampshire Fish and Game, Consulting Wildlife Biologist

Element 1: Distribution and Habitat

1.1 Habitat Description

The ruffed grouse uses deciduous and coniferous forests in both upland and wetland settings (DeGraaf et al. 1989). Ruffed grouse are early successional forest specialists. Grouse require four different cover types for drumming, brood rearing, nesting, and wintering. In general, they inhabit brushy, mixed-age woodlands, early successional to mature hardwood and mixed forests, often with aspen and birch as a component. Optimal habitat for ruffed grouse include young (6 to 15-year-old), even-age deciduous stands typically supporting 20-25,000 woody stems/ha (Gullion 1984). These habitats are available to grouse for approximately one decade because stem densities decrease rapidly through natural thinning as succession proceeds (Dessecker and McAuley 2001). Although commonly identified as an "edge" species, ruffed grouse association with habitat edges largely reflects their use of various interspersed forest habitats at different times of the year and their use of marginal habitats where quality habitat is lacking. They typically avoid hard-contrast edges (Dessecker and McAuley 2001).

Old orchards are an ideal fall habitat in New England (DeGraaf and Yamasaki 2001). Catkin-bearing trees are also an indicator of grouse habitat. They use logs or stone walls for drumming sites and dense cover for protection (Brooks and Birch 1988). Hens and broods prefer areas with a dense understory and fairly open herbaceous ground cover. Grouse nest and feed in hardwood stands and dust themselves in sunny openings. Ruffed grouse use mature woodlands, especially coniferous forests, during winter. When snow is deep and soft, birds will roost in the snow. Otherwise they will roost on the ground or in trees.

1.2 Justification

Ruffed grouse are found throughout much of the eastern United States, yet are common only where extensive tracts of forest dominate the landscape (Dessecker and McAuley 2001). The decline, fragmentation, and isolation of early successional forest habitats may be limiting ruffed grouse recruitment and therefore population densities (Dessecker and McAuley 2001).

1.3 Protection and Regulatory Status

Hunting regulations protect ruffed grouse in New Hampshire.

1.4 Population and Habitat Distribution

The ruffed grouse is a year-round resident in New England. They are more common inland than along the seacoast (DeGraaf and Yamasaki 2001), generally at elevations below 3,000 ft. Development poses a significant threat to grouse habitat in the lower third of the state, but pockets of grouse habitat should persist there for the foreseeable future. The Western Highlands and northern two-thirds of the state continue to provide extensive grouse habitat. Continual harvesting of mature forests of the industrial timberlands of northern New Hampshire produce quality grouse habitat (Robinson 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

Habitat conditions suitable for grouse are difficult to map using existing remotely sensed data (see Shrublands habitat profile, section 1.6).

1.7 Sources of Information

Two small game surveys are implemented annually. Small game sighting data are solicited from small game hunters and successful deer bow hunters, and these observations are used as an index of New Hampshire's small game species distribution and abundance. Ruffed grouse drumming routes have been run each spring since 1999. Two routes were established in each Wildlife Management Unit. These surveys are efficient at generating useful population data. Over time, survey results will provide invaluable trend data for management decision-making.

1.8 Extent and Quality of Data

Ruffed grouse have been studied and monitored since colonial times. With the implementation of these surveys in 1999, quality data exist on the relative abundance of these species.

1.9 Distribution Research

A better means of mapping grouse habitat is needed (see Shrublands habitat profile). An effort should be made to increase participation in the Small Game Survey to get better information on the abundance and distribution of grouse throughout the state.

Element 2: Species/Habitat Condition

2.1 Scale

Counties will be used as the conservation-planning unit for this habitat because that is the scale at which most information exists and because most technical and financial assistance (from the USDA NRCS, UNH Cooperative Extension, and others) is provided to private landowners by county.

2.2 Relative Health of the Population

Ruffed grouse populations naturally experience irregularly cyclical booms and crashes (Robinson 1994). Cyclical patterns aside, it is difficult to ascertain trends in the state's grouse population since drumming surveys just started in 1999. However, declines in early successional forest habitats and the isolation of these habitats in some landscapes may be limiting ruffed grouse recruitment and therefore population densities in some regions of the state (Dessecker and McAuley, 2001).

Forests in the northeastern Unites States were historically subject to several sources of disturbance (DeGraaf and Yamasaki 2003). Fire, wind, beaver (*Castor canadensis*), flooding, and Native American activity continually produced early successional forests (DeGraaf and Yamasaki 2003). Largely in response to forest maturation, young forest habitats have now become critically uncommon in much of the eastern United States and especially the Northeast (Brooks and Birch 1988, Trani et al., 2001).

Abandonment of agricultural lands reached a peak in New England in the late 1800s to mid-1900s and a wave of early successional habitats followed (Dessecker and McAuley 2001). Today, such habitats are less common than they were in pre-settlement times in several regions of the northeastern United States (Dessecker and McAuley 2001). On the other hand, the proportion of early successional habitat in northern industrial forests is currently several times that which occurred in pre-settlement times (Dessecker and McAuley 2001).

2.3 Population Management Status

Ruffed grouse are managed by hunting regulations. Season length and daily bag are determined on a biyearly basis.

2.4 Relative Quality of Habitat Patches

Because no young forest habitat map was created, it is difficult to assess habitat quality at the patch scale (see Shrubland Habitat Profile).

2.5 Habitat Patch Protection Status

Since no habitat map was generated, the habitat patch protection status of grouse habitat in New Hampshire is unknown. However, given the ephemeral nature of young forest habitats, tree harvesting and other vegetation manipulation techniques will need to be employed to generate suitable habitat for ruffed grouse. This can occur on both public and private land.

2.6 Habitat Management Status

Refer to element 2.6 in the shrubland profile for information on habitat management programs that assist with managing shrubland and other early-successional habitats.

2.7 Sources of Information

Sources of information for element 2 include journal articles, websites, GIS data, and white papers.

2.8 Extent and Quality of Information

It is difficult to assess the amount and condition of young forest habitats without an adequate habitat map to prioritize areas to field check.

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Fragmentation, Habitat Loss and Conversion)

(A) Exposure Pathway
Direct loss of shrubland habitat occurs through the conversion of these lands for residential, industrial, and commercial purposes. Development patterns lead to fragmentation of remaining undeveloped habitats, creating smaller patches that may not sustain wildlife populations and promoting generalist predators that prey on shrubland-dependent wildlife (Barbour and Litvaitis 1993, Litvaitis 2005).

(B) Evidence
New Hampshire's population grew by 17.2% from 1990 to 2004--the fastest growing state in the Northeast for the past four decades. New Hampshire has lost more than 17,000 acres of open space to development each year in the past five years (SPNHF, unpublished report).
Young forest habitats are important to a large suite of animals, including ruffed grouse (DeGraaf et al. 2005). Wildlife that utilizes young forest habitat conditions benefited from the wave of early successional habitats that followed the peak of farm abandonment in the late 1800s. As forests matured the amount of early successional habitats declined, leading to declines in associated wildlife species. In parts of New Hampshire, especially the southern tier, the amount of young forest habitat of functional quality for wildlife may now be falling below historic levels as current landscape conditions are strikingly different than in pre-settlement times (Brooks 2003, Litvaitis 2003, DeGraaf et al. 2005). Remaining patches of forest are broken up or fragmented into isolated patches. Species with small home ranges (such as ruffed grouse) may be able to occupy the remaining habitat patches. However, even these animals may be hampered by the consequences of human land uses that surround small patches of habitat. Increases in generalist predators may reduce or even eliminate small populations of prey species (Barbour and Litvaitis 1993, Oehler and Litvaitis 1996). Over time, these small patches may contain fewer species than similarly sized patches that are surrounded by extensive forests (Litvaitis 2005).

3.1.2 Altered Natural Disturbance (Natural Succession)

(A) Exposure Pathway
Shrubland-dependent vertebrate wildlife species require dense understory cover; their occurrence is influenced more by the height and density of vegetation than by specific plant communities (Litvaitis 2003). Ruffed grouse colonize a site after a woody understory is well developed (approximately 10 years post disturbance) and disappear from the site approximately 20 years post disturbance as the stand matures (DeGraaf et al. 2005). Hence populations of ruffed grouse and other young forest species shift in space and time in response to natural disturbances and human land uses (Litvaitis 2005). As more open land is converted to development there is less overall space for young forest-dependent species to shift into when natural forest succession or lack of active management makes their current habitat patch unsuitable.

(B) Evidence
The New England landscape has gone through dramatic changes over the last 350 years. In the mid 1800s, 75% of the arable land in central and southern New England was in pasture and farm crops. One hundred years later, New England was once again forested – a result of farm abandonment after richer farm fields opened up in the Midwest (DeGraaf et al. 2005). Today, about 80% of New Hampshire is forested again. However, the second growth forests lack the structural diversity including the range of seral stages present in pre-settlement forests (DeGraaf et al. 2005). The forests have matured, while natural disturbance processes, such as fire, have been disrupted, reducing the amount of early successional conditions (Litvaitis 2003, DeGraaf et al. 2005). The conversion of young forests to residential and commercial development combined with forest maturation (i.e., lack of disturbance) is reducing early successional habitat to levels at or below historical levels (Brooks 2003).

3.2 Sources of Information

Sources of information on threats to ruffed grouse and young forests included peer-reviewed scientific papers, GIS-analysis in reports by New Hampshire organizations, and gray literature.

3.3 Extent and Quality of Data

The decline in young forest habitats and their associated wildlife species is well documented.

3.4 Threat Assessment Research

No further research on threats seems warranted.

Element 4: Conservation Actions

4.1.1 Habitat Conservation, Habitat Protection

(A) Direct Threats: Development
(B) Justification
The pattern and magnitude of loss of open space in New Hampshire, especially the southern part of the state, is a major threat to sustaining wildlife habitats including early successional forests. Permanently protecting large blocks of forest suitable for forest management and the creation of young forest stands, especially in the south, will provide an opportunity to manage for natural early successional forests.

Fee simple acquisition of priority forest areas by NHFG or other partners will enable these agencies to manage for the range of wildlife species that depend on them, including ruffed grouse. Conservation easements can be used to ensure long-term management of these habitat types by private landowners. Given the pace of development and loss of open space in New Hampshire, this conservation action should receive priority, especially in the southern part of the state. Once lands are permanently protected the decision cannot be reversed, however, management decisions to benefit priority wildlife species can be adapted as needed.

(C) Conservation Performance Objective
The conservation objective is to permanently protect, through fee simple acquisition or conservation easements, forested habitats that provide opportunity to manage for young forest habitat conditions.

(D) Performance Monitoring
The measurable component is the acres of forestland that are permanently protected and managed.

(E) Ecological Response Objective
The ecological objective is to ensure that populations of ruffed grouse and other priority wildlife successfully reproduce in these permanently protected forestlands.

(F) Response Monitoring
Populations of ruffed grouse should be monitored to determine their reproductive success and to determine if additional management is needed to provide suitable habitat.

(G) Implementation
Habitat maps developed for the WAP will be analyzed to determine which remaining blocks of forested habitats provide the best opportunity for forest management including the establishment of young forest conditions (see Shrublands habitat profile).

(H) Feasibility
The ephemeral nature of early successional forests makes it difficult to permanently protect them. The best approach may be to identify large blocks of

forest that provide opportunity for forest management. The New Hampshire Land and Community Heritage Investment Program is a critical resource for maintaining and protecting large forest blocks, if new funds become available. Although permanent land conservation is typically more expensive than other conservation measures, this action may be required to sustain young forest-dependent wildlife.

4.1.2 Vegetation Management, Restoration, and Management

(A) Direct Threat: Altered Natural Disturbance (Natural Succession)

(B) Justification
Since young forest habitats are relatively short-lived (20 to 25 years in most cases), periodic management is needed to maintain this habitat type. Managing forest vegetation for a specific height and density should encourage many early successional species, depending on spatial scale and landscape context. Creating small patches of young forest habitats in a developing landscape may not yield desired results because of competing pressures of predation, disturbance, and the effect of fragmentation on wildlife movement. Managed habitats should be positioned near existing patches of shrubland, wetland, or a beaver flowage to maintain landscape-scale connectivity. Initially, the size of timber harvests would be larger than natural disturbances to offset the shortfall in early-successional habitat that currently exists (for example 4-10 ha) (Litvaitis 2005). As forests mature, management efforts (especially timber harvests) could then be patterned after canopy gaps (Runkle 1991) or modified to specific silviculture practices of a region (Seymour et al. 2002) if other forms of early-successional habitats (e.g. native shrublands and beaver impoundments) are adequately represented.

(C) Conservation Performance Objective
The conservation objective is to provide adequate young forest habitat conditions to sustain populations of ruffed grouse and other young forest-dependent wildlife.

(D) Performance Monitoring
The measurable component is the number and acreage of areas managed as young forest habitat.

(E) Ecological Response Objective
The ecological objective is to increase the amount of functional young forest habitat that supports ruffed grouse and other habitat associates.

(F) Response Monitoring
Drumming surveys in managed areas could be used as an index of abundance, and over time, indicate success of grouse management.

(G) Implementation
Large forested blocks suitable for forest management will first need to be identified. If in public ownership, then resource managers can manage the habitat. If on private lands, then an education and outreach program could be directed at landowners to maintain diverse habitats on their lands, including early successional habitats. UNH Cooperative Extension and the New Hampshire Coverts Program have an extensive network of landowners interested in wildlife and could be valuable partners in developing the means to educate landowners and facilitate forest management on private lands.

(H) Feasibility
NHFG can work with its state and federal partners to develop management plans on public lands that promote a variety of forested stages including blocks of young forests, and developing an education campaign on the importance of maintaining a suite of forested conditions including young forest habitats.

4.2 Conservation Action Research

An important step in maintaining young forest habitat conditions is the identification of large forest blocks conducive for forest management.

Element 5: References

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SPECIES PROFILE

Rusty Blackbird

Euphagus carolinus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G4
State Rank: S2
Author: Carol R. Foss, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat description

Breeding habitat for the rusty blackbird in New Hampshire consists of spruce-fir and mixed spruce-fir-hardwood forest adjacent to streams, ponds, bogs, fens, and beaver ponds at elevations between approximately 1,000 and 4,000 feet in the White Mountains Ecoregion.

1.2 Justification

This species has declined dramatically during the past few decades (NatureServe, Greenberg and Droege 1999, Niven et al. 2004). Breeding Bird Survey data from 1966 to 2001 indicate a statistically significant decline of 10.7% (Greenberg 2003), and Christmas Bird Count data suggest a 5.1% annual decrease between 1965 and 66 and 2002 and 2003. Descriptions of this species' abundance in bird distribution books, annotated checklists, and local checklists published during the twentieth century suggest a large scale, long-term decline that began between 1921 and 1950 (Greenberg and Droege 1999). Use of pesticides on the breeding and wintering grounds, destruction of wintering habitat, acidification of waterbodies on the breeding grounds, and efforts to control blackbirds on winter roosts may have contributed to the decline of this species.

1.3 Protection and Regulatory Status

This species is protected under the federal Migratory Bird Treaty Act

1.4 Population and Habitat Distribution

Population sizes are unknown at state, regional, and range-wide scales. Within New Hampshire, habitat is distributed at 1,000 to 4,000 ft elevation in and north of the White Mountains. The New Hampshire Breeding Bird Atlas documented confirmed breeding of this species in 9 locations, probable breeding in 6 locations, and possible breeding in 8 locations between 1981 and 1986. The Maine Breeding Bird Atlas Project (1978 to 1983) documented the presence of the species in 59 atlas blocks but confirmed breeding in only 14 blocks (Adamus 1987). A roadside survey of potential habitat in Maine during the 2001 and 2002 breeding seasons that included broadcast vocalizations documented the species at only 18 of 188 sites surveyed (Hodgman and Hermann 2003).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Published literature, New Hampshire Bird Records Database, unpublished report of field investigation in White Mountains.

1.8 Extent and Quality of Data

The New Hampshire Breeding Bird Atlas provides the most comprehensive data on Rusty Blackbird distribution in New Hampshire, based on fieldwork conducted between 1981 and 1986. Since then, the New Hampshire Bird Records database has documented serendipitous observations.

1.9 Distribution Research

- Survey all documented recent and historical occupied locations to determine current presence and population sizes
- Develop and validate model to describe potential habitat in New Hampshire
- Survey potential habitat identified by model using Maine protocol
- Monitor nesting success at occupied sites
- Determine wintering location(s) for New Hampshire breeding population

Element 2: Species/Habitat Condition

2.1 Scale

Based on recent distribution of rusty blackbirds in New Hampshire, it is appropriate to address the population and habitat of this species at the subsection scale, with sub-populations in the Connecticut Lakes, Mahoosuc-Rangeley Lakes, and White Mountains subsections. Although rusty blackbirds occur and occasionally breed in the northern portion of the New Hampshire Uplands Subsection, their occurrence there is scattered and sporadic, and this subsection is not addressed below.

2.2 Relative Health of Populations

Relative health of rusty blackbird populations is unknown, although available evidence suggests that the Connecticut Lakes sub-population may be the largest of the 3.

2.3 Population Management Status

The rusty blackbird is not currently managed.

2.4 Relative Quality of Habitat Patches

- *Connecticut Lakes Subsection*: Unknown. Extensive and intensive harvesting of spruce-fir forests in some areas of this subsection may have degraded breeding habitat. Acidification of water bodies in breeding habitat may be less severe in this than in the White Mountains Subsection.
- *Mahoosuc-Rangeley Lakes Subsection*: Unknown. Extensive and intensive harvesting of spruce-fir forests in some areas of this subsection may have degraded breeding habitat. Acidification of water bodies in breeding habitat may be less severe in this than in the White Mountains Subsection.
- *White Mountains Subsection*: Unknown. National Forest Management policies protect high elevation and riparian vegetation. Acidification of foraging wetlands may be more severe in this subsection.

2.5 Habitat Patch Protection Status

- *Connecticut Lakes Subsection*: Much of the breeding habitat in this subsection is within the easement area of the Connecticut Lakes Headwaters.
- *Mahoosuc-Rangeley Lakes Subsection*: Some breeding habitat in this subsection is within the Lake Umbagog National Wildlife Refuge, the Nash Stream Forest, the Bunnell Preserve, and the Kilkenny section of the White Mountain National Forest. However, much of the habitat in this subsection is on industrial forestlands that have been intensively harvested in recent years.
- *White Mountains Subsection*: Most of the breeding habitat in this subsection is within the White Mountain National Forest.

2.6 Habitat Management Status

No habitat is being managed specifically for this species.

2.7 Sources of Information

Personal knowledge and consultation with experts.

2.8 Extent and Quality of Data

No data exist regarding either water level or forest management for currently occupied rusty blackbird habitat in New Hampshire.

2.9 Condition Assessment Research

- Determine protection/ownership status of occupied habitat

- Determine water level and forest management policies and practices for occupied habitat
- Determine water quality, riparian vegetation characteristics, and aquatic insect diversity for occupied habitat

Element 3: Species and Habitat Threat Assessment

3.1.1. Acid Deposition

(A) Exposure Pathway
Acid deposition depletes the natural buffering capacity of water body, pH of water body decreases to a level that is toxic to sensitive aquatic species, populations of sensitive species are extirpated from water body, and numbers of emerging insects are low at critical times in breeding cycle.

(B) Direct Evidence
Species richness of phytoplankton, protozoans, zooplankton, periphyton, and macroinvertebrates declines with decreasing pH (Hoffman et al. 1995). Mayfly, stonefly, and caddisfly larvae are particularly sensitive to reduced pH, and biomass has declined in some acidified lakes and streams (Okland and Okland 1986). New England receives high levels of acid deposition (National Acid Precipitation Assessment Program 1991). No data are available regarding macroinvertebrate abundance and species composition at New Hampshire wetlands currently or historically occupied by rusty blackbirds.

3.1.2. Agriculture

(A) Exposure Pathway
Control measures, including the use of lethal agents are used to reduce numbers of blackbirds depredating grain crops and creating large night roosts in the southern and south-central United States during the non-breeding period. Although red-winged blackbirds are the primary target species, rusty blackbirds feed primarily on crop and weed seeds during the non-breeding season, and lethal control agents are designed to target icterids in general. Another potential pathway is through ingestion of toxic maggots in wetland areas. Birds that have ingested the poison DRC-1339 typically seek water and die in or near wetlands. Their carcasses can provide an excellent substrate for *Clostridium botulinum*, and maggots feeding on the carcasses can ingest the botulism toxin, resulting in an outbreak of avian botulism among birds feeding on the maggots.

(B) Direct Evidence
Rusty Blackbirds winter in bottomlands, swamps, and riparian areas and forage in open fields (Avery 1995). Their winter diet includes crops and weed seeds (Martin et al. 1951) as well as various invertebrates (Beal 1900, McCaskie 1971). Wintering locations for New Hampshire's rusty blackbird breeding population are not known, so direct evidence of poisoning in these wintering areas is lacking.

3.2 Sources of Information

Published literature.

3.3 Extent and Quality of Data

No data are available regarding the application of these threats specifically to New Hampshire's rusty blackbird breeding population.

3.4 Threat Assessment Research

- Compare water quality and aquatic insect diversity for currently occupied habitat, historical habitat that is no longer occupied, and unoccupied potential habitat as identified by physical characteristics
- Compare soil chemistry in currently successful breeding areas, currently unsuccessful breeding areas, and abandoned historical breeding areas
- Identify wintering areas for New Hampshire's breeding population and determine history of blackbird control measures, current blackbird control policies and practices, and history of wetland loss at these sites

Element 4: Conservation Actions

4.1.1. Regulate lethal blackbird control in wintering areas. See Strategies: Regional Coordination, Advise IAFWA Regional Coordination Team.

4.1.2. Advise IRAT for acid deposition.

4.2 Conservation Action Research

Before conservation action research can be designed, threat research must be completed.

Element 5: References

5.1 Literature

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5.2 Data sources

New Hampshire Bird Records database

SPECIES PROFILE

Salt Marsh Sharp Tailed Sparrow

Ammodramus caudacutus

Federal Listing: Not listed
State Listing: Special concern
Global Rank: G4
State Rank: S3B
Authors: Megan J. McElroy and Kimberly J. Babbitt, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

In New Hampshire, saltmarsh sharp-tailed sparrows (hereafter, saltmarsh sparrow) inhabit salt marshes, which are grass-dominated tidal wetlands existing in the transition zone between ocean and upland (Niering and Warren 1980) (see Salt Marshes habitat profile). They breed in marshes where smooth cordgrass, saltmeadow grass, and blackgrass are bordered by cattail, reed, and marsh elder (Greenlaw and Rising 1994). Sparrows forage on the ground in dense, wet grasses (e.g., cordgrass, blackgrass), areas of wrack, and edges of ditches, pools, and salt pannes (Greenlaw and Rising 1994). Their diet consists mainly of adult and larval insects, spiders, and amphipods. Grass seeds and herbaceous plants become an important part of their diet during fall migration (Greenlaw and Rising 1994).

1.2 Justification

Saltmarsh sparrows were designated a species of high conservation priority by Partners in Flight (Breeding Tier I). In New Hampshire, the saltmarsh sparrow is a species of special concern. Saltmarsh sparrows have a restricted breeding range with 90% occurring in the Northeast (DiQuinzio et al. 2001). Therefore, protecting saltmarsh sparrow populations and their breeding habitat in the Northeast is critical to global survival of this species. Few data exist on population trends and threats, especially in New Hampshire. No long-term studies of this species have been conducted in New Hampshire. Habitat loss and degradation are probably the most pressing threats to salt marsh sparrows in New Hampshire.

Saltmarsh sparrow breeding success is related to the size of habitat patches (Shriver et al. 2004). Large patches of good-quality salt marsh habitat must be available across the landscape for sparrow populations to persist and grow. Invasive reeds and grasses, such as cattails and common reed, have replaced typical salt marsh vegetation in marshes where undersized culverts and other structures restrict tidal flooding (Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998). Areas of invasive plants in and around salt marshes decrease available habitat for saltmarsh sparrows because they are not suitable habitat.

The current lack of knowledge regarding saltmarsh sparrow populations in New Hampshire and threats to these populations parallels that for other closely related salt marsh birds, such as Nelson's sharp-tailed sparrow and seaside sparrow. Additional research and monitoring may allow this salt marsh guild to serve as an indicator of marsh health, the effects of marsh degradation, and the success of habitat restoration and other management practices.

1.3 Protection and Regulatory Status

- The Migratory Bird Treaty Act of 1918 legally protects saltmarsh sparrows from the take, transport, and use of the species, including eggs, nests, and feathers.
- NHDES regulates human impacts on salt marshes. Activities that may involve filling, dredging, or destroying wetlands are subject to strict guidelines and require approved permits before work can commence (RSA 482-A).

1.4 Population and Habitat Distribution

Saltmarsh sparrows breed on the Atlantic Coast of North America from southern Maine to North Carolina (Sibley 1996). Saltmarsh sparrows inhabit salt marshes in southeastern New Hampshire (Gavutis 1994, NHBR, McElroy and Babbitt, unpublished data). Data collected in 2004 indicate 3 distinct breeding clusters: Great Bay, Rye, and a small portion of the Hampton salt marshes (McElroy and Babbitt, unpublished data). The distribution and patchiness of saltmarsh sparrow populations have changed over the last century because of large-scale changes in their habitat.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

A literature review was conducted to obtain information on saltmarsh sparrow habitat, populations, distribution, and status. NHA database of bird records provided historical information on the distribution of saltmarsh sparrows in New Hampshire. Detailed information on current population distribution and status came from data collected in 2004 by researchers from UNH.

1.8 Extent and Quality of Data

Historical bird records from NHA consist of sightings reported by birders. Although this information is vital for understanding historical distribution, it does not offer an accurate view of population size or confirmed breeding locations throughout the state. The most extensive dataset to date comes from UNH researchers. It includes confirmed breeding locations and population estimates throughout the state, but covers only one year. Long-term trends in population locations and sizes in New Hampshire are still unknown.

1.9 Distribution Research

A long-term survey of salt marsh habitat specifically for saltmarsh sparrows (i.e., point counts conducted during breeding season at established points) is needed to determine distribution of the species in New Hampshire. Long-term surveys are necessary because the quality of salt marsh habitat changes over time, potentially affecting saltmarsh sparrow populations from one breeding season to the next.

Element 2: Species/Habitat Condition

2.1 Scale

The New Hampshire conservation units for saltmarsh sparrow are Great Bay and Portsmouth and Coast (including Rye, Hampton, and Seabrook).

2.2 Relative Health of Populations

In New Hampshire, the abundance of saltmarsh sparrows during the breeding season is estimated at approximately 275-300 individuals (McElroy and Babbitt, unpublished data). Because a long-term survey of saltmarsh sparrows has not yet been implemented and Breeding Bird Survey routes do not sufficiently cover salt marshes, data on population trends are not available. Data collected during the 2004 breeding season showed sparrows at the following locations, categorized by breeding activity (Confirmed Breeding = nests found and/or fledglings observed; Possible Breeding = adults present throughout season, singing activity, no evidence of nests and/or fledglings; Potential Breeding = a few birds present feeding at some point in the season, no evidence of any current breeding activity) (table 1). Estimated Relative Abundance (ERA) categories are also included.

2.3 Population Management Status

Currently no population management efforts focus on saltmarsh sparrows in New Hampshire (see Salt Marshes habitat profile).

2.4 Relative Quality of Habitat Patches

Saltmarsh sparrows tend to breed in large (greater than 20 hectares), unrestricted, *Spartina*-dominated marshes with pannes, pools, and creeks or ditches for foraging (Greenlaw and Rising 1994, McElroy and Babbitt, unpublished data). However, sparrows may occupy marshes that do not meet those criteria and may be absent from marshes that do meet the criteria. Consequently, any salt marsh in New Hampshire could provide key ecological attributes. For example, small marshes might not be suitable nesting habitat but may serve as important stopover sites. More research is needed to understand the factors that determine habitat quality for salt marsh sparrows.

2.5 Habitat Patch Protection Status

See Salt Marshes habitat profile (element 2.5)

2.6 Habitat Management Status

See Salt Marshes habitat profile (element 2.6)

2.7 Sources of Information

A literature review was performed to obtain information on research and habitat management. Research by UNH scientists provided information on the population and management status. Information on habitat protection, restoration, and management came from the New Hampshire Coastal Program's website.

2.8 Extent and Quality of Data

Currently, the most extensive dataset comes from researchers at UNH and includes confirmed breeding locations and population estimates throughout the state. However, this dataset covers only one field season. Therefore, a long-term study is needed for an adequate assessment of population health and habitat suitability.

2.9 Condition Assessment Research

Long-term monitoring of saltmarsh sparrow populations is essential for knowledge of population dynamics, trends, and ecology. Monitoring will provide valuable data to increase understanding of the threats to saltmarsh sparrow and the effects of habitat management efforts.

Surveys are needed to determine abundance of saltmarsh sparrows at sites used by the species. This will provide a more accurate assessment of marshes that rank high in priority for protection or conservation. Because this species is non-territorial, point-count surveys and similar methods cannot accurately estimate population abundance. A long-term mark-recapture banding effort would provide a more accurate estimate of sparrow abundance at key sites.

A long-term dataset of presence/absence and abundance estimates at marshes throughout New Hampshire could serves as the basis for a GIS map of locations with high densities of breeding birds. This information is critical for conservation and research efforts for saltmarsh sparrows in New Hampshire and for understanding habitat suitability for this species.

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

See Salt Marshes habitat profile

3.1.2 Development (Fragmentation)

See Salt Marshes habitat profile

3.1.2 Altered Hydrology (Tidal Restriction), Transportation Infrastructure

See Salt Marshes habitat profile

3.2.2Introduced Species (Introduced Plants), Development (Habitat Loss and Conversion)

(A) Exposure Pathway

Disturbance to a site, such as the construction of a road restricting tidal flow, can exacerbate the spread of invasive plants (Niering and Warren 1980, Benoit and Askins 1999). In New Hampshire's salt marshes, the most threatening invasive species is common reed (*Phragmites australis*) (NHCP). Purple loosestrife (*Lythrum salicaria*) and narrow-leaf cattail (*Typha angustifolia*) also can disrupt the salt marsh plant community (NHCP). Increased runoff of fresh water and storm water from developed land surrounding the marsh causes lower soil salinities in the marsh, changes in soil saturation levels, sedimentation, and increased erosion. These conditions promote the spread of invasive species (NHCP).

(B) Evidence

Dense, monotypic stands of common reed provide unsuitable or less preferable habitat and food for many wildlife species (Roman et al. 1984). According to Benoit and Askins (1999), saltmarsh sparrows, a species normally found in *Spartina* grasses, are unlikely to use a marsh dominated by tall, thick stands of common reed. The density of the reed stands may reduce foraging success or make prey inaccessible (Benoit and Askins 1999). Benoit and Askins (1999) found that saltmarsh sparrows were much less abundant in brackish mixture, cattail, and common reed survey plots than in short-grass meadow plots.

3.2.3 Altered Hydrology (Mosquito Ditching), Altered Natural Disturbance

(A) Exposure Pathway:
By the 1930s, about 90% of salt marshes from Maine to Virginia had been ditched for mosquito control (Reinert et al. 1981, Clarke et al. 1984, Post and Greenlaw 1994). The ecological impacts of parallel or grid ditching include reduced flood duration, lowered water table, changes in species composition throughout the marsh, and reductions in invertebrate populations. Today, ditching to eliminate breeding sites of the salt marsh mosquito (*Aedes sollicitans*) is viewed as totally unnecessary and ineffective (Reinert et al. 1981). However, old ditches still affect salt marsh hydrology and health.

(B) Evidence
Mosquito ditching reduces the abundance of cordgrass, an essential habitat feature for breeding saltmarsh sparrows, by draining standing water on the marsh surface (Brawley et al. 1998). Therefore, ditched marshes are potentially less suitable for saltmarsh sparrows because they are drier and may not provide a sufficient food supply of invertebrates. In a study of avian use of ditched and unditched marshes in Rhode Island, the density of saltmarsh sparrow females was higher in unditched marshes (53.4 females/100 hectares) than in ditched marshes (34.5 females/100 hectares) (Reinert et al. 1981).

3.2.4 Mercury, Non-Point Source Pollution

(A) Exposure Pathway
Deposition and biomagnification of mercury in aquatic ecosystems is a major environmental issue (Shriver et al. 2002, Kamman et al. 2004). Mercury is emitted into the atmosphere from the combustion of fossil fuels, medical waste, and municipal waste and then deposited on the landscape (Kamman et al. 2004). Ultimately, mercury accumulates in watersheds and bioaccumulates to upper trophic levels in wetland and other aquatic systems (Kamman et al. 2004). Salt marshes receive pollution and stormwater runoff from lakes, rivers, storm drains, roads, and construction areas (NHCP). Saltmarsh sparrows are insectivorous during the breeding season, feeding primarily on immature and adult insects, supplemented by other arthropods and small mollusks (Greenlaw and Rising 1994). It is possible that saltmarsh sparrows are harmed by mercury deposition and could be indicators of methylmercury availability in New England salt marshes (Shriver et al. 2002).

(B) Evidence
The Biodiversity Research Institute in Maine has conducted numerous studies on methylmercury exposure in birds (BRI: www.briloon.org). Elevated methylmercury levels in birds have the potential to disrupt behavior, physiology, and reproductive success (Lane and Evers 2005). Recently, saltmarsh sparrows have become an increasing conservation concern. Researchers at the Biodiversity Research Institute are conducting studies to assess mercury exposure and risk to saltmarsh sparrows and other passerines breeding in New England salt marshes (see Shriver et al. 2002, Lane and Evers 2005). Lane and Evers (2005) found elevated levels of mercury in saltmarsh sparrow blood sampled at several sites from Maine and Massachusetts. In 1998-2000, 5 birds at Scarborough Marsh in Scarborough, Maine, had foot and/or beak deformities (Lane and Evers 2005).

3.2.5 Sources of Information

Information on threats to saltmarsh sparrows was obtained from a literature review, New Hampshire Coastal Program, NHNHB, and Biodiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

Threats to saltmarsh sparrows have only recently gained significant attention from researchers and managers. It is well documented that historical marsh degradation from human activities is correlated with decreases in sparrow populations. However, researchers studying the effects of mercury and wetland restoration are attempting to evaluate the significance of these new threats to saltmarsh sparrows and other salt marsh nesting birds. Therefore, although the potential for these threats to occur and affect sparrow populations is documented, continued research of these threats and their impacts on sparrow populations is warranted.

3.4 Threat Assessment Research

Threats to saltmarsh sparrow populations are currently being investigated and documented throughout the northeast in Maine, Massachusetts, Connecticut, and Rhode Island (see references for published studies). Researchers at UNH have started to examine threats to the state's sparrow populations, but more research is needed. For example, the impact of invasive plant species and the impact of increased human disturbance of habitats surrounding marshes (e.g., increased road density and noise) are two important areas for future research.

More research is needed to determine the effects of methylmercury on saltmarsh sparrow populations in New Hampshire. The effect of methylmercury has become a widespread regional ecological and human health concern. The Biodiversity Research Institute has started to investigate the effects of mercury on salt marsh birds in New England, but research is needed in New Hampshire. Salt marsh birds are species of high conservation priority regionally due to habitat loss and degradation. However, mercury may pose an increasing threat to these populations. Once mercury effects have been assessed through scientific research, conservation actions can be implemented to combat the issue.

Element 4: Conservation Actions

4.1.1 Protecting remaining salt marsh habitat and surrounding upland buffer habitat, Habitat Protection (See Saltmarsh Habitat Profile)

(A) Conservation Performance Objective
For saltmarsh sparrows, the salt marsh and upland buffer protection performance objective is to maintain a *Spartina*-dominated, tidal system with suitable nesting and foraging habitat. The objective for each individual site is to maintain salt marsh structure, function, and value for saltmarsh sparrow habitat. At sites currently occupied, or that could potentially be occupied, by saltmarsh sparrows, the objective would be to maintain the current habitat structure and function. The ultimate goal for the performance objective is to preserve salt marsh habitat with structure and function that does or potentially could maintain a breeding population of saltmarsh sparrows.

(B) Performance Monitoring:
Performance monitoring should be conducted at as many salt marshes (larger than 15 hectares for saltmarsh sparrows) as possible, or at sites of high priority or concern, on a regular basis. For saltmarsh sparrows, monitoring and research should focus on: habitat use (migration/breeding), abundance, density, breeding and nesting activity, nest success, foraging success, and site population trends.

(C) Ecological Response Objective
The desired ecological response to salt marsh protection is persistence of saltmarsh sparrow populations (current or new) with stable or increasing densities at all potential sites. This response should be immediate at natural, undisturbed sites that are protected from further human disturbance and development.

(D) Response Monitoring
The response indicator for successful marsh protection is stabilizing or increasing population trends at occupied sites. Therefore, the most essential and basic monitoring tool for this response is conducting bird surveys. Bird surveys, such as standardized point counts, conducted during the breeding season on an annual basis, can determine presence or absence at a particular site. Nest monitoring is also beneficial and more reliable than surveys at confirming a site as a breeding and nesting location. These data should initially be collected every breeding season until long-term population information for all potential sites in New Hampshire is obtained and trends are deemed stable or increasing. At this point, monitoring frequency could be reduced—for example, sampling at each site during 1 breeding season every 3 years.

4.1.2 Restoring degraded salt marshes back to Spartina-dominated systems, Restoration and Management (See Salt Marsh Habitat Profile)

(A) Conservation Performance Objective
Specifically for saltmarsh sparrows, the salt marsh restoration performance objective is to create a *Spartina*-dominated, tidally-influenced system with suit-

able nesting and foraging habitat. The objective for an individual site is to establish marsh structure and function comparable to that of natural, undisturbed marsh systems occupied by saltmarsh sparrows. With limited quantifiable data on time period for restoration success, Warren et al. (2002) suggests that full restoration of ecological functions, including sparrow breeding, can occur within 2 decades. Therefore, the ultimate goal for the performance objective is to create habitat with salt marsh structure and function that potentially could sustain a breeding population of saltmarsh sparrows, within 20 years of restoration.

(B) Performance Monitoring
Annual performance monitoring should be conducted at all restoration sites, including pre-restoration monitoring, if feasible. If pre-restoration monitoring is not possible due to time constraints or severity of marsh degradation, then reference site monitoring is acceptable. All monitoring and research activities should be conducted at reference sites and restoration sites to to allow assessment of restoration success. Monitoring should be performed until at least 15-20 years after restoration to determine long-term outcomes. For saltmarsh sparrows, monitoring and research priorities for assessing restoration success include: habitat use (migration/breeding), abundance, density, breeding and nesting activity, nest success, foraging success, and site population trends.

(C) Ecological Response Objective:
The desired ecological response to marsh restoration is colonization of restored sites by saltmarsh sparrows and stable or increasing populations over time. This response should be observed within approximately 15-20 years after restoration (Warren et al. 2002). Ultimately and ideally, saltmarsh sparrow abundance and population trends should be comparable to that of similar reference sites. Successful marsh restoration, in terms of saltmarsh sparrows, will be measured by the colonization and continued presence of successfully breeding sparrows (i.e., source population, or stable or increasing population size).

(D) Response Monitoring:
The response indicator for successful marsh restoration is the colonization and continued presence of successfully breeding saltmarsh sparrows. Therefore, like habitat protection, the most essential and basic monitoring tool for this response is bird surveys. Bird surveys such as standardized point counts conducted during the breeding season on an annual basis can determine presence or absence of the species. Nest monitoring is also beneficial in determining nest success at a restored site. These data should initially be collected every breeding season until long-term population information for restored sites in New Hampshire is obtained and trends are deemed stable or increasing. At this point, monitoring frequency could be reduced—for example, sampling during 1 breeding season every 3 years.

Element 5: References

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5.2 Data Sources:

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PIF (Partners in Flight). Species assessment database. Bird conservation regions: breeding scores for BCR 30 and BCR 14. PIF homepage: http://www.rmbo.org/pif/pifdb.html

Element 6: List of Figures

Table 1. New Hampshire salt marshes with saltmarsh sharp-tailed sparrows during the 2004 breeding season (McElroy and Babbitt, unpublished data).

MARSH	TOWN	BREEDING	ERA
Bay Road	Newmarket	Confirmed	16 – 30
Pierce Point	Greenland	Confirmed	< 15
Drakeside Road	Hampton	Confirmed	31 – 50
Hampton Beach	Hampton	Confirmed	> 100
Squamscott River	Newfields	Confirmed	16 – 30
Fairhill Marsh	Rye	Confirmed	31 – 50
Rye Beach	Rye	Confirmed	16 – 30
Chapman's Landing	Stratham	Confirmed	16 – 30
Sagamore Creek	Portsmouth	Possible	< 15
Awcomin Marsh	Rye	Possible	16 – 30
Hampton River	Hampton	Potential	< 15
Little River	North Hampton	Potential	< 15

SPECIES PROFILE

Seaside Sparrow

Ammodramus maritimus

Federal Listing: Not listed
State Listing: Not listed legally, but identified as of special concern
Global Rank: G4
State Rank: S1B
Authors: Megan J. McElroy and Kimberly J. Babbitt, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

Seaside sparrows inhabit salt marshes, or grass-dominated tidal wetlands existing in the transition zone between ocean and upland (Niering and Warren 1980) (see Salt Marshes habitat profile). In New England, seaside sparrows breed in both high and low marsh areas where smooth cordgrass, saltmeadow grass, and blackgrass dominate (Post and Greenlaw 1994). Sparrows forage mostly in open stands of smooth cordgrass, areas of wrack, and the edges of ditches, pools, and salt pannes (Post and Greenlaw 1994). Their diet consists primarily of adult and larval insects, spiders, and amphipods (Post and Greenlaw 1994).

1.2 Justification

Seaside sparrows are designated a species of high conservation priority by Partners in Flight (Breeding Tier I) (PIF) and a species of special concern in New Hampshire. Long-term studies of this species have not been conducted in New Hampshire, and few data exist on population trends, estimates, and threats in the state. Habitat loss and degradation are probably the most pressing threats to seaside sparrows in New Hampshire.

Seaside sparrows are salt marsh obligates and area-sensitive. High-quality salt marsh habitat available in large patches across a landscape is required for population persistence and growth. Tidal restrictions in salt marshes have resulted in invasive reeds and grasses, such as cattails and common reed, replacing salt marsh vegetation (Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998). Areas of invasive plants in and around salt marshes decrease the suitable habitat for seaside sparrows.

The current lack of knowledge of seaside sparrow abundance and threats in New Hampshire is similar to that for closely related salt marsh birds, such as the saltmarsh sharp-tailed sparrow and Nelson's sharp-tailed sparrow. Human impacts on salt marshes are thought to affect these species in similar ways. Additional research and monitoring may allow this salt marsh guild to serve as an indicator of marsh health, the effects of marsh degradation, and the success of management practices such as restoration.

1.3 Protection and Regulatory Status

- The Migratory Bird Treaty Act of 1918 legally protects seaside sparrows from the take, transport, and use of the species, including eggs, nests, and feathers.
- NHDES regulates activities that affect salt marsh habitat. Activities that may involve filling, dredging, or destroying wetlands are subject to strict guidelines and require approved permits before work can commence (RSA 482-A).

1.4 Population and Habitat Distribution

The geographic range of the seaside sparrow includes the Atlantic and Gulf coasts of North America (Post 1974). In northern New England, seaside sparrow populations are uncommon, relatively small, and susceptible to local extinction (Marshall and Reinert 1990). New Hampshire is the historical northern edge of the breeding range for seaside sparrows along the Atlantic coast. In New Hampshire, seaside sparrows have only been located in 1 marsh within the large Hampton salt marsh complex during the breeding season (Gavutis 1994, NHBR, McElroy and Babbitt, unpublished data). This marsh, a historical site for breeding, is located off Route 1A in Hampton between Routes 101 and 101E (Gavutis 1994, NHBR, McElroy and Babbitt, unpublished data).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

A literature review was conducted to obtain habitat, distribution, and population status information for seaside sparrows. The NHA database of Bird Records gave historical information on the distribution of seaside sparrows in New Hampshire. A population survey in 2004 by researchers at UNH provided information on current abundance and distribution.

1.8 Extent and Quality of Data

Historical bird records from NHA are sightings reported by birders. Although this information is vital to understanding historical distribution, it does not accurately describe population size or confirmed breeding locations throughout the state. The most comprehensive dataset comes from UNH researchers, and it indicates no breeding populations of seaside sparrows in New Hampshire. Although that dataset is spatially extensive, it covers only one year. Significant gaps still exist in knowledge of this species in the state, and long-term trends in population locations and sizes in New Hampshire are still unknown.

1.9 Distribution Research

Because of their habitat requirements, breeding seaside sparrows are likely to be found only in Hampton. A long-term survey (i.e., point counts during breeding season) throughout the Hampton marsh is recommended.

Element 2: Species/Habitat Condition

2.1 Scale

The New Hampshire conservation unit for seaside sparrow is the Coast (including Rye, Hampton, and Seabrook).

2.2 Relative Health of Populations

Fewer than 5 seaside sparrows are thought to live in New Hampshire during the breeding season (McElroy and Babbitt, unpublished data). Because a long-term survey of seaside sparrows has not been conducted and Breeding Bird Survey routes do not sufficiently cover salt marshes, population trends are unknown. In 2004, a complete survey of all potential breeding sites in New Hampshire's salt marshes in New Hampshire revealed no evidence of breeding activity. One individual was observed during a visit to the site of known historical occurrence for this species (see table 1) (McElroy and Babbitt, unpublished data).

In New Hampshire, the seaside sparrow is at the periphery of its geographic range. Therefore, it is scarce and not widely distributed in the state. New populations are unlikely to colonize sites in New Hampshire. The best potential for a breeding population is at the known historical breeding site: the Route 1A/101 marsh in Hampton. In 1985, a breeding population of 6-8 pairs of seaside sparrows occurred at this site (Gavutis 1994), but that level of abundance has not been recorded in subsequent years (NHBR). In the breeding seasons of 1986 through 2001, few seaside sparrows were reported, and from 2002 to 2004 only 1 individual was reported each breeding season (NHBR). All reported sightings during the breeding season occurred at the historical breeding site at the Hampton marsh.

2.3 Population Management Status

There are no ongoing population management efforts for seaside sparrows in New Hampshire. The only site where seaside sparrows currently occur in New Hampshire is the Route 1A/Route 101 marsh in Hampton. Therefore, this site would be high priority for any conservation actions.

2.4 Relative Quality of Habitat Patches

Throughout their range, seaside sparrows breed in large, unrestricted, *Spartina*-dominated marshes with pannes, pools, and creeks for foraging (Post and Greenlaw 1994). The historical site for seaside sparrows off Route 1A in Hampton is dominated by smooth cordgrass and salt hay, and it has many pannes, pools, and creeks (see Salt Marshes habitat profile).

2.5 Habitat Patch Protection Status

See Salt Marshes habitat profile (element 2.5).

2.6 Habitat Management Status

See Salt Marshes habitat profile (element 2.5).

2.7 Sources of Information

A literature review was performed to obtain information on research and habitat management. Research conducted by UNH scientists was used to determine the current status of the population and management efforts. Information on habitat protection and management came from the New Hampshire Coastal Program's Web site and published articles on restoration efforts.

2.8 Extent and Quality of Data

The most extensive dataset comes from a survey conducted by scientists at UNH. However, it covers only one field season. A long-term study is needed to assess population trends and habitat suitability. Significant gaps exist in knowledge of seaside sparrow populations in the state and the effectiveness of habitat restoration.

2.9 Condition Assessment Research

A complete survey is needed for seaside sparrows in the marshes of Hampton, New Hampshire. Long-term, standardized point counts during the breeding season could be used to identify areas of sparrow use and potential breeding sites. Maps based on long-term monitoring of sparrow presence/absence, abundance, and breeding activity could be produced to discern key spots for research, conservation, and habitat protection. This information is vital for conservation and research efforts for seaside sparrows and assessment of habitat suitability in New Hampshire. The lack of research and monitoring of salt marsh-dependent birds in New Hampshire leaves open the possibility that marshes outside of Hampton marsh provide suitable habitat for aspects of seaside sparrow life history (e.g., migratory stopover sites).

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

(A) Exposure Pathway
See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

(B) Evidence
Habitat loss is a primary factor in the decline of wetland birds, especially species such as the seaside sparrow that depend on salt marshes for nesting (Post and Greenlaw 1994). Seaside sparrows tend to occur in large, contiguous marsh systems, making them vulnerable to habitat loss through land development.

3.2.2 Development (Fragmentation, Habitat Coversion Loss and Conversion)

See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

3.2.3 Altered Hydrology (Tidal Restriction), Transportation Infrastructure

See Saltmarsh Sharp-tailed Sparrow profile

3.2.4 Altered Hydrology (Mosquito Ditching), Altered Natural Disturbance

See Saltmarsh Sharp-tailed Sparrow profile

3.2.5 Introduced Species (Introduced Plants), Development (Habitat Loss and Conversion)

See Saltmarsh Sharp-tailed Sparrow profile

3.2.6 Mercury, Non-Point Source Pollution

See Saltmarsh Sharp-tailed Sparrow profile

3.3 Sources of Information

Information on threats to seaside sparrows was obtained from a literature review, New Hampshire Coastal Program, NHNHB, and Biodiversity Research Institute in Gorham, Maine.

3.4 Extent and Quality of Data

Threats to seaside sparrows have recently gained significant attention from scientists and managers. It is well documented that marsh degradation from human activities correlates with declines in sparrow populations. Researchers studying mercury are attempting to evaluate the significance of this new threat to seaside sparrows and other salt marsh nesting birds.

3.45Threat Assessment Research

Scientists are investigating threats to seaside sparrow populations throughout the northeast in Massachusetts, Connecticut, and Rhode Island (see references for published studies). Two important areas for future research are impacts of invasive plants and increased human disturbance near marsh habitat (e.g., road density and noise).

More research is needed to determine the effects of methylmercury on seaside sparrow populations in the region. Methylmercury has become a widespread ecological and human health concern. The Biodiversity Research Institute is investigating the effects of mercury on salt marsh birds in New England. Once mercury's impacts are determined through scientific research, conservation actions can combat the issue.

Studies of sparrow abundance are needed to provide a foundation for threat assessment. Little is known about New Hampshire's seaside sparrows, such as whether a breeding population exists.

Element 4: Conservation Actions

4.1.1 Protecting remaining salt marsh habitat and surrounding upland buffer habitat, Habitat Protection

See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

(C) Conservation Performance Objective

The conservation performance objective is to maintain or improve salt marsh structure and function in areas that could serve as breeding sites for seaside sparrows, such as the Hampton marsh that historically was documented as a breeding site.

(D) Performance Monitoring

Performance monitoring should be conducted regularly at large salt marshes within the conservation unit, especially the Hampton marsh along Route 1A. Monitoring and research should include habitat use (migration/breeding), abundance, density, breeding, nesting activity, and site population trends.

(E) Ecological Response Objective

The desired ecological response to salt marsh protection is stabilized or increasing populations of seaside sparrows at one or more sites. The response should begin immediately at natural, undisturbed sites protected from further human disturbance. Salt marsh protection would be deemed successful if 2 to 4 pairs breed annually in Hampton.

4.1.2 Restoring degraded salt marshes back to Spartina-dominated systems, Restoration and Management

See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

(D) Performance Monitoring

The Hampton marsh complex is the most likely site for any future colonization by seaside sparrows. Portions of the marsh on the Blackwater River and Hampton River were ditched extensively. Any habitat restoration initiatives to raise water level on the marsh could benefit seaside sparrows by increasing smooth cordgrass abundance. Assessment of restoration success with respect to seaside sparrows should include habitat use (migration/breeding), abundance, density, breeding and nesting activity, nest success, foraging success, and site population trends.

(F) Response Monitoring

The response indicator for successful marsh restoration is the colonization and persistence of breeding seaside sparrows. Bird surveys, such as standardized point counts, conducted during the breeding season on an annual basis can be used to determine presence or absence at a restored site. Monitoring should be conducted every breeding season over the long term until the data indicate stable or increasing populations. Subsequently, monitoring frequency could be reduced to sampling perhaps 1 breeding season every 3 years.

Element 5: References

5.1 Literature:

Benoit, L. K., and R. A. Askins. 1999. Impact of the spread of Phragmites on the distribution of birds in Connecticut tidal marshes. Wetlands 19:194-208.

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SPECIES PROFILE

Sedge Wren
Cistothorus platensis

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S1
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

In the core of its breeding range, the sedge wren uses wetlands dominated by sedges or grasses. Such areas include wet hayfields, sphagnum moss bogs, and the margins of ponds (Herkert et al. 2001), and in these habitats, they prefer shrub cover. The species does not use wetlands with sparse vegetative cover or those dominated by cattails (Typha sp.). Historically, coastal populations in the Northeast also occurred in salt marshes.

Recent verified reports from New Hampshire come from several habitat types. Three or 4 (depending on definition) are from wet shrubby areas at the margins of marshes or wet meadows, 2 are from weedy grass fields, and 1 or 2 are from tussock marshes.

Historic sites with a clear pattern of occupancy may provide clues as to the species' habitat preferences in New Hampshire. Such sites include Cherry Pond (Jefferson), Danbury Bog (Danbury), and Merrymeeting River (Alton/New Durham). Habitat at the first 2 locations is characterized by shallow, emergent, grassy wetland with high shrub density. There may also be bog-like vegetation at all 3 sites, here defined as floating or partially floating mats of sphagnum that support a mix of heaths and herbaceous species typical of bogs and fens. Similar habitat is present along Turee Brook in Concord and Bow, where the species was common in the early 1900s (White 1924, 1937).

Sedge wrens tend to breed earlier in the west than in the east (Herkert et al. 2001), and most documented breeding happens in the Northeast between July and September. This phenological difference makes many records from New Hampshire problematic, since early-season sightings may represent transients rather than potential breeders.

1.2 Justification

The sedge wren has never been common in New Hampshire, which is generally considered the edge of its range in North America. In the late 1800s and early 1900s, it was recorded in Rye (Dearborn 1903) and Bow Bog and in other areas around Concord (White 1924, 1937), where it was relatively common. Additional localities in the early 1940s included sites in Andover, Hanover, Fitzwilliam, Manchester, and Sutton (Records of New England Birds). From the late 1940s onward, sedge wren reports in New Hampshire have dwindled, with the largest decrease occurring from the late 1960s to the early 1970s (figure 1). Since 1980, there has been an average of only 1 report every 3 years.

1.3 Protection and Regulatory Status

- Migratory Bird Treaty Act (1918)
- New Hampshire Endangered Species Conservation Act (RSA 212)
- Sedge wren habitat is protected by wetland statutes administered by the New Hampshire Department of Environmental Services.

1.4 Population and Habitat Distribution

A map of sedge wren locations in the state (figure 2) shows several clusters appearing in different times. Clusters are defined as areas with at least 5 historical records in an area roughly 24 km in diameter (with the exception of the Squam cluster). These clusters are listed in table 1. Smaller clusters include Colebrook (4 records), southern Merrimack County (Concord/Dunbarton, 4 records), Androscoggin River (Errol/Dummer, 3-4 records), Fitzwilliam (3 records), and Merrymeeting River (Alton/New Durham, 3 records, 1949-50).

Sedge wrens have historically been uncommon in the region - here including New England, New York, the Mid-Atlantic States, and eastern Canada. Within this region, populations appear to be concentrated to the south (Chesapeake and Delaware Bays) and west (Great Lakes/St. Lawrence Valley) (Gibbs and Melvin 1992). In the latter region, data from the New York State Breeding Bird Atlas do not appear to indicate any change in range from the early 1980s to the present (New York State Department of Environmental Conservation 2004), although some data indicate that the population has declined from historic levels (Andrle and Carroll 1988). Similar declines have been noted in Massachusetts (Veit and Petersen 1993).

In contrast, populations appear to be increasing at the core of the species' range, including in parts of the Midwest and eastern Great Plains (Sauer et al. 2004). Data from Christmas Bird Counts suggest that winter populations (which presumably reflect breeding populations) in the southern United States increased between 1980 and the early 1990s, at which point they leveled off or declined slightly (National Audubon Society 2002). Irrespective of local population status, it appears that the sedge wren has always been at the periphery of its range in New England.

1.5 Town Distribution Map

See figure 2.

1.6 Habitat Map

N/A

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Data on sedge wren distribution in New Hampshire were compiled from New Hampshire Bird Records (NHBR), a database maintained by New Hampshire Audubon.

1.8 Extent and Quality of Data

Given the species' recent scarcity in the state, the available data are probably insufficient to fully warrant conservation should action be desired. In addition, the potential for confusion with the similar marsh wren (Cistothorus palustris) makes even evaluation of historic records problematic.

1.9 Distribution Research

Although sedge wrens are too scarce in New Hampshire to warrant any species-specific inventory or monitoring projects, there may be value in searches of recently active sites to determine if the species is still present. Any broad wetland bird monitoring project should include this species, and should ensure that observers can identify it.

Element 2: Species/Habitat Condition

2.1 Scale

Given the inconsistent temporal and spatial nature of sedge wren records in New Hampshire, it is probably inappropriate to address the species' conservation at any scale smaller than the entire state. Even locations with a history of records (table 1) have rarely hosted the species for more that 2 years in a row, so it is essentially impossible to determine which factors – if any – were responsible for the species' disappearance. The species is somewhat nomadic, so its absence should not be construed as evidence for poor habitat quality.

2.2 Relative Health of Populations

Data provide no clear evidence for the presence of a persistent sedge wren population in New Hampshire. The species has not been present for more than 1 year at any location for the last 30 years, and although populations are known to shift locations, this paucity of records suggests that most, if not all, sedge wrens in the state originate beyond our borders. There are 9 sites known to support the species in the state. One of the once more reliable locations in the state is Danbury Bog (6 records 1950-1964 and one in 1990). One other site of interest is the Pondicherry Refuge in Jefferson and Whitefield, which hosted wrens between 1958 and 1964.

2.3 Population Management Status

Sedge wren populations are not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

The ephemeral nature of site occupancy for this species makes evaluation of habitat quality difficult, if not impossible. Since large areas of potential habitat are unoccupied, even the presence of sedge wrens may not be a good indicator of suitable habitat. More data are needed on actual breeding status at occupied sites.

2.5 Habitat Patch Protection Status

Many older records of this species lack information on specific locality, so the analysis that follows is based primarily on sites known to support the species since 1979. Of 9 such locations for the species, 6 (67%) are protected in whole or in part by easement or fee-simple (e.g. Danbury bog and Pondicherry Refuge).

2.6 Habitat Management Status

No habitat management has occurred for sedge wrens in New Hampshire.

2.7 Sources of Information

Data on site occupancy were compiled from NHBR. Limited data on habitat quality and management were obtained from the literature.

2.8 Extent and Quality of Data

Data on sedge wrens and their habitat in New Hampshire is spatially and temporally inconsistent.

2.9 Condition Assessment Research

Data on sedge wren distribution are not sufficient to determine potential habitat or the condition of habitat at historic locations.

Element 5: References

5.1 Literature

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Element 6: List of Figures

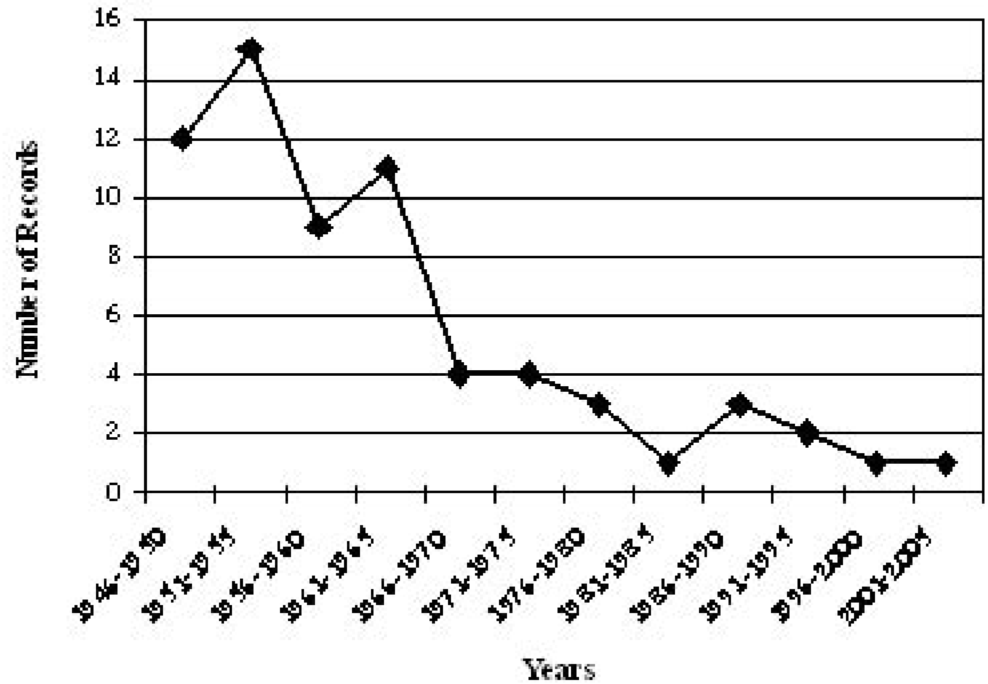

Figure 1. Relative abundance of sedge wrens in New Hampshire, 1946-2003. Numbers represent the total numbers of reports in a given five year period, without correction for multiple records from the same location within the time period.

Cluster	Towns included	# of records	Dates of sedge wren records	Records with breeding evidence*
nw Merrimack County	Danbury, Andover, Wilmot, Sutton	13	1938, 1949-52, 1954, 1960, 1964, 1989, 1990?	Andover: June 1938
				Danbury: Jul 1954
Squam Lake area	Sandwich, Meredith, New Hampton	10	1947-49, 1952, 1957, 1959, 1973, 1979, Atlas (early 1980s)	
Cherry Pond	Jefferson, Whitefield	7	1958, 1960-1964	Summer 1958
Southwest	Walpole, Marlow, Westmoreland, Keene	7	1949, 1955, 1958, 1960, 1963, 1968	Roxbury: Sept 1968
Seacoast	Durham, Newmarket Kensington, E Kingston	7	1954, 1963, 1967, 1969, 1985, 1994, 2001	Newmarket: Jun 1985
				Kensington: May-Jun 1994
				Durham: Jul-Aug 2001

Table 1. Distribution of historical records of sedge wren in New Hampshire, 1937 to 2003. Only clusters (see text) with at least 5 records are included.

* "breeding evidence" is defined as one of the following: 1) present on territory for at least 2 weeks, 2) multiple singing males, 3) evidence of a mated pair, 4) nest building, or 5) young.

SPECIES PROFILE

Semipalmated Sandpiper

Calidris pusilla

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: SNA , New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Semipalmated sandpipers use beaches, mudflats, tundra, sandy areas along rivers and ponds, and dotted sand dunes during the summer for feeding and nesting (Godfrey 1986, Peterson 1980). Coastal mudflats and intertidal zones are used for feeding and staging areas in preparation for migration (DeGraaf and Yamasaki 2001, Boates and Smith 1989). Evidence shows high fidelity to migratory staging areas, and females tend to return to the same breeding areas, especially if they were successful in raising young the previous year (Gratto 1992). Sandpipers are territorial and monogamous during the breeding season.

1.2 Justification

Approximately 71% of the regional population migrates through New Hampshire, with 200 to 600 birds occurring along the coast during migration (Hunt 2005). The primary threat to these populations is degradation of coastal and inland wetlands, where the birds make crucial stopovers on their long migratory route between northeast North America and wintering areas in South America (Senner and Howe 1984; Lank 1989; Gratto et al. 1981, 1987, 1988, 1992). Development along the Atlantic coast has resulted in significant habitat loss and degradation and has exposed semipalmated sandpiper habitat to increased pressure from human recreation (United States Fish and Wildlife Survey 1985, National Survey on Recreation and the Environment 1994).

1.3 Protection and Regulatory Status

- Migratory Birds Convention (1916)
- Migratory Bird Treaty Act (1918)
- BCR 14 moderate concern
- BCR 30 moderate concern

1.4 Population and Habitat Distribution

Semipalmated sandpipers are possibly the most abundant shorebird (NatureServe 2005), with flocks of up to 300,000 birds observed in key wintering and migratory staging areas (Gratto 1992). International Shorebird Survey data taken during migration did not show significant declines in semipalmated sandpipers in the past 12 years (Howe et al. 1989). The total population is estimated to be 3.5 million (Morrison et al. 2001).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See coastal sand dune systems.

1.7 Sources of Information

Information on semipalmated sandpiper habitat, population distribution and status was collected from literature, NatureServe data, and the internet.

1.8 Extent and Quality of Data

Semipalmated sandpipers have been well studied during migration, but little is known about their wintering biology, and breeding biology has only been studied in Alaska and northern Manitoba (Gratto 1992).

Data on the local distribution of the species are limited. Increased and consistent monitoring efforts, combined with intensive management of human recreation in feeding and migration areas, are needed.

1.9 Distribution Research

Conservation and preservation of migratory areas are vital to the population's survival. Although protecting key staging areas is crucial, much of the population depends on the many smaller staging areas distributed throughout the migration route, such as the New Hampshire coast. Management along the New Hampshire coast should include managing human recreational uses in coastal sand dunes and along mudflats as well as increasing public education and outreach. The possibility of restoring salt marshes to create feeding areas should also be investigated.

Element 5: References

5.1 Literature

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SPECIES PROFILE

Spruce Grouse

Falcipennis canadensis

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3
Author: Jillian R. Kelly, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Spruce grouse prefer dense conifer forests and low-elevation bogs (Boag and Schroeder 1992, Smith 1994). Forest structure, rather than specific tree species, greatly influences spruce grouse (Greenwald 1984); tree species commonly associated with spruce grouse habitat in New England include black spruce, tamarack, and balsam fir (Bryant and Kuropat 1980, Allen 1985). Structural components important to spruce grouse include forest openings, bog edges, trees with live branches extending to the ground, and sparse ground cover with optimum forage such as *Vaccinium* (Robinson 1980). In the winter, spruce grouse feed entirely on short conifer needles (NatureServe 2005). New Hampshire natural communities associated with spruce grouse habitat include high-elevation spruce-fir, high elevation balsam fir, black spruce-red spruce, lowland spruce-fir, and peatlands.

1.2 Justification

Although spruce grouse habitat in the East is naturally patchy, anthropogenic destruction of spruce-fir habitat has further contributed to extreme isolation of spruce grouse populations (Keppie 1997). Anecdotal evidence (limited chick and female sightings) suggests that spruce grouse are declining in New Hampshire. High market demands for spruce and fir has led to extensive cutting of mature softwood habitat at lower elevations.

In New Hampshire, Weeks (quoted in Silver 1957) stated that spruce grouse were common in Coos County at the time of settlement, but by 1880, they were seldom seen. Habitat loss, market hunting, and susceptibility of populations to harvest were thought to be the primary causes (Silver 1957).

1.3 Protection and Regulatory Status

Spruce grouse are a species of conservation concern but are not listed in New Hampshire. Spruce grouse cannot be hunted in New Hampshire (RSA 209:4). Spruce grouse are listed in other states/provinces, including Vermont (endangered), New York (endangered), Nova Scotia (Uncommon), Minnesota (Uncommon), Wisconsin (Threatened), and Michigan (Uncommon) (Lumsden and Weeden 1963).

1.4 Population and Habitat Distribution

Spruce grouse are distributed throughout the northern United States and Canada. In the East, the southern range limit includes northern Minnesota, Wisconsin, Michigan's Lower Peninsula, New York, Vermont, northern New Hampshire, and eastern Maine (AOU 1983).

According to Silver (1957), spruce grouse were historically common as far south as the Berkshire Hills and Worcester County, Massachusetts. Today, spruce grouse in New Hampshire can be found in and north of the White Mountains. In most cases, there is very little overlap between spruce grouse and ruffed grouse habitat. Common densities of spruce grouse in suitable habitat are around 12-24 grouse/mi^2, as opposed to 80 or more ruffed grouse/mi^2 in suitable habitat (Johnsgard 1983, Greenwald 1984, Robinson 1980).

1.5 Town Distribution Map
Figure 1.

1.6 Habitat Map
See the high elevation spruce-fir map.

1.7 Sources of Information

Information on spruce grouse habitat was derived from the high elevation spruce-fir map. Information on population distribution and status was collected from recent research (Todd 2003), New Hampshire Fish and Game data, public observation records, Audubon bird records, Breeding Bird Survey (BBS) data (Hunt 2005), and Breeding Bird Atlas (BBA) locations (Smith 1994).

1.8 Extent and Quality of Data

Data on New Hampshire's spruce grouse populations are limited. There are few historic or recent data on distribution and abundance, particularly data collected in a systematic manner. Current information is based largely on general observations, Audubon bird records, observation records collected from the public, and surveys conducted for the Breeding Bird Atlas for New Hampshire (Smith 1994). BBS survey methods are poor for detecting spruce grouse.

1.9 Distribution Research

New Hampshire needs a systematic assessment of spruce grouse populations and habitat.

Element 2: Species Condition

2.1 Scale

Spruce grouse primarily occur in three areas: Connecticut Lakes, Mahoosuc-Rangeley region, and the White Mountains (Figure 1). Habitat polygons within subsections will be aggregated to form planning units.

2.2 Relative Health of Populations

Connecticut Lakes region: Historically, spruce grouse were likely abundant in the Connecticut Lakes region due to the extensive spruce-fir habitat. Overall, spruce-fir habitat has declined due to current and historic land use. Spruce grouse may persist sporadically throughout low-elevation spruce forests, but populations may be isolated and unstable (Keppie 1997). High elevation spruce-fir habitat is more common and likely maintains spruce grouse populations in the region.

Mahoosuc-Rangeley region: Historically, spruce grouse were likely abundant within the Mahoosuc-Rangeley region, especially along the Androscoggin River Valley in lowland spruce-fir forests and bogs. Spruce grouse persist in low elevation habitats, but populations may be isolated and unstable (Keppie 1997). They may be more abundant at higher elevations where forest cutting has not been as intense.

White Mountains region: Historically, spruce grouse were abundant in the White Mountains wherever spruce-fir habitat occurred (low and high elevations). Spruce grouse persist in isolated high elevation habitats, but preliminary data suggest that productivity may be low and populations may be unstable (Keppie 1997, Todd 2003). Furthermore, spruce grouse in high elevation habitat may be subjected to longer and colder temperatures, resulting in late breeding and decreased annual production (Todd 2003).

2.3 Population Management Status

In the Connecticut Lakes and Mahoosuc-Rangeley regions, NHFG has placed signs showing the difference between spruce grouse and ruffed grouse at locations where hunters/hikers may encounter both species. Observation data come from interviews with NHFG personnel. High elevation bird surveys are periodically conducted in the White Mountain National Forest (last survey 1993-1997). Past research projects on spruce grouse have also concentrated on habitat found in the White Mountain subsection (Todd 2003).

2.4 Relative Quality of Habitat Patches

Connecticut Lakes region: Conserved land within the Connecticut Lakes region has excellent potential to support spruce grouse. Increasing and improving the amount of spruce-fir within this subsection will improve foraging opportunities for spruce grouse.

Active habitat management will also allow for pre-commercial thinning and release of softwood regeneration to promote the growth of branches extending out near ground level for displaying males. Cover for spruce grouse will be improved by providing closed canopy spruce-fir to provide overhead cover as protection from predators. Small openings, interspersed (patch cuts) will also promote productivity by providing dense cover and feeding opportunities for young.

Mahoosuc-Rangeley region: Conserved land within the Mahoosuc-Rangeley subsection may also support spruce grouse, but unlike the Connecticut Lakes subsection, most of the conserved habitat is at higher elevations. This may require different research and management objectives. Unconserved land has the highest potential for providing spruce grouse habitat within this subsection. Under timber investment and industrial ownership, historical habitat has drastically declined and continues to be harvested at an accelerated pace.

White Mountain region: Populations currently persist in the White Mountain subsection, but are likely isolated due to fragmentation of habitat patches (Todd 2003).

2.5 Habitat Patch Protection Status

Connecticut Lakes region: Within the Connecticut Lakes subsection, the majority of both high elevation spruce-fir and low elevation spruce-fir habitat is protected under conservation easement or fee ownership. The Connecticut Lakes Timber Company currently owns 146,400 acres of working forest that is under easement. NHFG owns in fee 25,000 acres within the subsection. High elevation habitat that remains unprotected includes most of Crystal Mountain and Blue Ridge, as well as Sanguinary and Rice Mountain Ridges. Low elevation habitat that remains unprotected can be primarily found in the Clarksville and Colebrook vicinity. Unincorporated towns have some level of protection through zoned districts.

Mahoosuc-Rangeley region: The majority of the high elevation spruce-fir habitat in the Mahoosuc-Rangeley subsection is currently protected through easement or title fee. Unprotected high elevation habitat includes Dixville/Mt. Kelsey mountain ridge. Low elevation spruce-fir habitat in the Mahoosuc-Rangeley subsection remains virtually unprotected. Unincorporated towns have some level of protection through zoned districts.

White Mountain region: High elevation spruce-fir habitat in the White Mountains subsection is entirely protected by the White Mountain National Forest (WMNF). Under the Proposed Land and Resource Plan for the WMNF, wind towers can be considered as well as ski area expansions in designated areas. Virtually all of the low elevation spruce-fir is under federal ownership as part of the WMNF. Unincorporated towns located within the subsection also have some level of protection through zoned districts.

2.6 Habitat Management Status

Connecticut Lakes region: Under the Connecticut Lakes Headwaters DRAFT stewardship plan, a primary goal is to increase the overall occurrence of spruce-fir in all size classes. Under the stewardship plan for the Connecticut Lakes Natural Area (CLNA, NHFG ownership), a primary goal for the property is to establish and maintain wildlife habitats that provide for game and non-game wildlife species native to the Connecticut Lakes Ecoregion. Specific consideration will be given to the landscape context and habitat availability existing outside the boundaries of the CLNA, with emphasis on those species considered rare or of conservation concern. Boreal forest species are a specific target for this goal. Unincorporated towns located within the subsection have specific zoning for critical wildlife habitat (PD3 zones), high elevation habitat above 2700 feet in elevation (PD6 zones), wetlands (PD7 zones), and unusual areas (PD8 zones).

Mahoosuc-Rangeley region: Conserved land within the Mahoosuc-Rangeley subsection includes the Vicki Bunnell preserve, Nash Stream State Forest, Kilkenny section of the WMNF, and the Randolph Town Forest, all of which have specific goals for promoting boreal forest and wildlife species within their boundaries. Unincorporated towns located within the subsection have specific zoning for critical wildlife habitat (PD3 zones), high elevation habitat above 2,700 ft in elevation (PD6 zones), wetlands (PD7 zones), and unusual areas (PD8 zones). The majority of low-lying spruce-fir habitat found within this subsection remains in large landownership and therefore has extreme pressure placed on it for producing softwood timber.

White Mountain region: Virtually all of the White Mountains subsection is made up of the WMNF. Under the Proposed Land and Resource Plan for the WMNF (2004), there is an overall objective of increasing softwood (from 12 to 24%) throughout the forest. Furthermore, the age class objectives for softwood is to have 59-63 % of all softwood as mature habitat, and 30% as old habitat. Mature forest structure can be a problem in regions where spruce grouse have declined. Spruce grouse directly benefit from forest management designed to keep pockets of habitat in earlier successional stages (NatureServe 2005). Unincorporated towns located within the subsection have specific zoning for critical wildlife habitat (PD3 zones), high elevation habitat above 2700 feet in elevation (PD6 zones), wetlands (PD7 zones), and unusual areas (PD8 zones).

2.7 Sources of Information

Information on habitat protection and management was obtained from literature review, expert review, consultation (W. Staats, and J. Kanter, NHFG, personal communication), the Draft of the Connecticut Lakes Headwaters Forest Stewardship Plan, the Draft Plan for Connecticut Lakes Natural Area, Zoning Ordinances for Coos County Unincorporated Places and the WMNF Proposed Land and Resource Management Plan.

2.8 Extent and Quality of Data

Systematic assessments include New Hampshire BBA and BBS. Overall, there is little to no information on the distribution, size, and connectivity of local spruce grouse populations in New Hampshire.

2.9 Condition Assessment Research

Research could include a systematic assessment of distribution, habitat assessment, survivorship of chicks and juveniles, juvenile dispersal, and population connectivity.

Element 3: Species Threat Assessment

3.1.1 Unsustainable Harvest (Forestry Operations and Management)

(A) Exposure Pathway
The exposure pathway is the method and timing of timber harvesting that converts spruce-fir stands to different forest types (specifically deciduous), thus resulting in a direct loss of spruce grouse habitat. Consequently, individual spruce grouse populations become isolated or locally extinct.

(B) Evidence
Spruce grouse population isolation is well documented in the WMNF (Todd 2003). Population isolation outside the forest, although not documented, is suspected to be more extensive and severe at some locations (W. Staats, NHFG, personal communication). Preliminary habitat mapping shows a high rate of spruce-fir conversion as well.

3.1.2 Unregulated Take (Incidental Take)

(A) Exposure Pathway
Upland bird hunters mistaking spruce grouse for ruffed grouse

(B) Evidence
Incidental takes that are collected and reported to conservation officers. Currently <1 incidentally shot spruce grouse are reported each year (J. Kelly, NHFG, personal communication).

3.2. Sources of Information

Information on threats was taken from Silver (1957), Todd (2003), Keppie (1997), and expert review and consultation (W. Staats, NHFG, personal communication).

3.3. Extent and Quality of Data

Scant data exist on the threats to isolated populations, especially outside the WMNF. The current extent of incidental take is localized to the Connecticut Lakes subsection, with suspected occurrence within the Mahoosuc-Rangeley subsection (J. Kelly, NHFG, personal communication).

3.4. Threat Assessment Research

Potential threat assessment research would include collecting information methods for retaining/creating spruce grouse habitat, methods for maintaining large landownership, and studies on juvenile dispersal, population expansion, and habitat recolonization rates. Better data collection and reporting methods are also needed to document incidental takes of spruce grouse.

Element 4: Conservation Actions

4.1.1 Increase the amount of suitable spruce-fir habitat for spruce grouse through habitat management and protection, Restoration and Management

(A) Direct Threat: Unsustainable Harvest (Forestry Operations and Management)

(B) Justification
Increasing the effective population size of spruce grouse in Acadian spruce-fir habitat is directly linked to managing for and promoting spruce-fir at lower elevations. The spatial scale of the action meets the spatial scale of the threat because it is a distribution wide approach to spruce grouse habitat loss.

(C) Conservation Performance Objective
The desired outcome is to increase the amount of Acadian spruce-fir habitat to provide connectivity between spruce grouse populations throughout historic Acadian spruce-fir distribution. This long-term objective will likely take 30 years or more.

(D) Performance Monitoring
Restoration of suitable spruce-fir habitat can be monitored by documenting the amount of spruce-fir statewide and by monitoring spruce grouse populations within these habitats.

(E) Ecological Response Objective
Spruce grouse populations can be monitored to assess the extent and quality of spruce-fir habitat. As effective population size is reached and maintained, the conservation action can be reassessed. Where appropriate, emphasis can be shifted away from habitat protection and toward management for structure beneficial to spruce grouse (e.g., small forest openings interspersed within spruce-fir cover). Successful population restoration will be indicated by greater than 50% of identified potential habitat being occupied by spruce grouse. Most beneficial to spruce grouse would be a large area with a mosaic of even-aged stand of spruce-fir, including an array of different ages classes (Boag and Schroeder 1992).

(F) Response Monitoring
Areas for potential high elevation habitat monitoring would include the WMNF, Vicki Bunnell Preserve (The Nature Conservancy), Kilkenny section of the WMNF, Nash Stream State Forest (Long Mountain), and a variety of privately owned high mountain ridges. Low elevation locations would include East Inlet (CLNA and TNC), and Bog Branch of Cedar Stream (CLNA, South Bay Bog), Perry Ponds (Pittsburg), CLHW property, Molligewock (Cambridge), Second College Grant (Bennett Brook), Lake Umbagog NWR, Success, and Pondicherry NWR. Baseline data should be developed for each location and monitored on a 2-5 year interval.

(G) Implementation
Increasing effective population size is a long-term process that should be monitored based on the amount and location of spruce-fir restored across the landscape. NHFG, WMNF, the New Hampshire Department of Resources and Economic Development, and the U.S. Fish and Wildlife Service can perform the identified actions at the appropriate and identified locations. Technical assistance can be provided to private landowners to maximize Acadian spruce-fir.

(H) Feasibility: 1.72

4.1.2 Promote education and knowledge of spruce grouse distribution and habitat, especially in popular ruffed grouse hunting locations, Education and Outreach and Regulation and Policy

(A) Direct Threat
Human recreation- incidental take
(B) Justification
Increasing awareness will benefit spruce grouse by in-

fluencing the way that people perceive spruce grouse and their habitat. As a result, people may be more likely to report sightings and pay more attention to the habitat they are in while hunting, and be less apt to incidentally take a spruce grouse. The spatial scale of the action is appropriate for the scale of the threat because the effort will be implemented throughout historic spruce grouse distribution.

(C) Conservation Performance Objective:
Conservation performance objectives will include identifying and placing signs at more locations, encouraging conservation officers to become more interactive with hunters to explain the differences between spruce grouse and ruffed grouse.

(D) Performance Monitoring
The method for monitoring the performance of the education and outreach effort would be a decrease in the number of incidentally taken spruce grouse. Yearly interviews with District 1 Conservation Officers are currently being used to collect this information. If it is deemed that incidental takes are having impacts on local populations, more intensive area posting/signage can be used.

(E) Ecological Response Objective
The desired ecological response of the conservation action is to decrease or eliminate incidental shootings of spruce grouse. A measurable indicator of the desired ecological response is a decrease in the number of birds taken, and a better understanding from the hunting public regarding spruce grouse and their habitat.

(F) Response Monitoring
Response monitoring can be done through field interviews with hunters and interviews with local conservation officers.

(G) Implementation
Signs have already been designed and used at some locations. Prior to 1 October 2005 the signs should be reviewed, finalized, and printed on a durable surface that can withstand outdoor conditions. Interviews with the Conservation Officers are currently done on an informal basis. Providing a summary of some of the information that would be beneficial to the objective may be presented in an interoffice memo prior to the hunting season. Field interviews at locations where signs are posted may be warranted on a specific location basis depending on the amount of activity or potential for incidental shooting of spruce grouse.

(H) Feasibility: 3.06
This task would be highly feasible. NHFG is currently responsible for most of the tasks, which are ongoing and could be slightly expanded to provide more of an impact. Funding requirements would only be for the cost of sign printing and staff time to place them at specified locations. Local chapters of the Audubon and conservation groups could be used to maintain signage and perform informal interviews.

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SPECIES PROFILE

Three-Toed Woodpecker

Picoides dorsalis

Federal Listing: Not listed
State Listing: Threatened
Global Rank: G5
State Rank: S1
Author: Laura S. Deming, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

The three-toed woodpecker inhabits boreal and montane coniferous forests of Canada and the northern United States, from Alaska to California in the west, and northern Wisconsin east to northern New York and northern New England. This species is a year round resident throughout its range, where it occurs in sites with abundant dead and dying trees caused by disease, fire, flooding, insects, wind, and pollution. In the east, they occur at elevations from 360 to 1,250 m (1,180 to 4,100 ft) (Winkler et al. 1995).

Although three-toed woodpeckers are closely associated with spruce forests, the composition of occupied habitats varies across its range. In eastern North America, this species has been found in moist coniferous habitats, such as bogs and spruce-fir swamps. Three-toed woodpeckers in Michigan and Vermont commonly occur in black spruce, tamarack, and balsam fir swamps (Van't Hof and Van't Hof 1983, Oatman 1985). In New York, breeding pairs often choose nest sites in spruce-larch forests with stands of dead trees surrounding open bogs, or black spruce bogs among the Adirondack High Peaks (Leonard 2001, Peterson 1988). In New Hampshire, three-toed woodpeckers inhabit spruce-fir forests, bogs, and logged areas with standing dead conifers in the North Country and above 3,000 ft (910 m) in the White Mountains (Foss 1994). In northern Maine, they have been found in mixed hardwood old growth forests (Gunn and Hagan in Leonard 2001). In Canada, they may be found in mixed conifer and riparian willow habitats, and they have been observed occasionally in isolated hardwood-dominated stands in St. Lawrence lowlands (Leonard 2001). Nests may be dug in dead or dying coniferous or deciduous trees, or in hard or soft snags or stumps with diameters of at least 12 in (31 cm) (Foss 1994). Nest trees are often near water.

1.2 Justification

The three-toed woodpecker is locally common in the western part of its range and rare in eastern North America. Its quiet, reclusive nature and relatively inaccessible habitat contribute to this species being under-recorded by most surveys. Historic observations indicate that this species is less common than the black-backed woodpecker, which shares its habitat throughout North America.

Three-toed woodpeckers feed primarily on bark beetles, which are most abundant on dead and dying trees with shedding bark, and therefore require standing dead trees for foraging. Suitable habitats with abundant dead and dying trees are created through natural disturbances such as fire, wind, disease, insect outbreaks, flooding, and human activities such as logging. However, extensive logging of coniferous forests has reduced the amount of standing dead and dying timber over the past 150 years. In addition, beaver activity, insect outbreaks, salvage logging of affected stands, and suppression of forest fires, have reduced and degraded former three-toed woodpecker habitats.

Three-toed woodpeckers have been studied very little in North America, so there are too few data to determine significant changes in population distribution or abundance. However, long-term studies in northern Europe have correlated Eurasian woodpecker decline there with activities common here (beavers, salvage logging, fire suppression, habitat fragmentation, etc.). North American Breeding Bird Survey (BBS) data indicate significant annual declines of 15.0% for the United States and 13.4% across North America. However, these results are based on a very small sample size (just 12 survey routes for the United States, and 18 for all of North America), and very low abundances of three-toed woodpeckers on each route (J. Sauer personal communication in Leonard 2001).

Despite relatively low abundance and lack of data, several observers have noted declines in this species over the past century. Forbush (1927 in Oatman 1985) noted that their numbers in Vermont had likely been reduced by extensive logging of spruce forests in the eighteenth and nineteenth centuries, and both Saunders (1929) and Bull (1974) indicated three-toed woodpeckers had become scarcer in New York. In Maine, declines in this species were attributed to timber harvesting (Hagan et al. 1997). The few observations in New Hampshire since 1884 indicate that three-toed woodpeckers occupy a small number of historic sites (Foss 1994).

1.3 Protection and Regulatory Status

The three-toed woodpecker is protected in the United States under the Migratory Bird Treaty Act of 1918 and in Canada under the Migratory Birds convention Act of 1994. It is considered a Sensitive Species by the United States Bureau of Land Management and Region 4 of the United States Forest Service (USFS), and is a Watch Species by the United States Fish and Wildlife Service (USFWS). It is listed as a Species of Special Concern in Idaho, a Sensitive Species in Utah, a Species of Concern in Washington, A Sensitive Species in Oregon, and a Rare and Uncommon Native Species in Vermont.

In New Hampshire, three-toed woodpeckers are listed as Threatened. This designation makes it unlawful to kill, possess, process, sell or offer for sale, deliver, carry, transport or ship such species within the state or export them from the state. Three-toed woodpeckers have also been identified as species of conservation concern by the New Hampshire Living Legacy Project, New Hampshire Important Bird Areas Program, the New Hampshire Forest Resources Plan Ecological Assessment, the White Mountain National Forest (WMNF), and by the New Hampshire Natural Heritage Bureau.

1.4 Population and Habitat Distribution

In New Hampshire, three-toed woodpeckers have been documented in the North Country and in the White Mountains, with Mt. Passaconaway (Waterville Valley) being the southern-most location documented in the state (Foss 1994). The earliest documentation of three-toed woodpeckers in New Hampshire was in August 1884, of a female and young bird shot below Hermit Lake in Tuckerman's Ravine. The second documented record was in July 1886, of a bird observed in the Great Gulf Wilderness (Chadbourne 1887 in Foss 1994). A few reports of three-toed woodpecker sightings followed until the 1950s, when sightings became more frequent. Since 1884, sightings have been documented in at least 12 towns, from Waterville Valley to Pittsburg (table 1). All but 2 of these reports were of observations during the breeding season. Two reports were of birds seen in October, one at an unknown location in Bethlehem (where the reporter indicated he had seen them there previously) in 1981, and one on the Isreal Ridge Trail on Mt. Adams in 1996. Both of these locations are areas where three-toed woodpeckers have been seen during the breeding season.

1.5 Town Distribution Map

See figure 1.

1.6 Habitat Model

Zapisocki et al. (2000) developed a Habitat Suitability Index Model for three-toed woodpeckers in west-central Alberta that includes the following within-stand features:

- Average diameter at breast height (dbh) of canopy trees
- Average top height of 100 coniferous trees/ha that have the largest dbh
- Total density of standing dead trees or stubs greater than or equal to 16 cm (6.3 in) dbh per hectare
- Percent composition of pine, spruce, fir, and larch species in the tree canopy
- Percent of ground covered by a vertical projection of tree crown areas on to the ground

- Includes trees greater than or equal to 8 cm (3.2 in) dbh

These features describe the year-round requirements for foraging, nesting, and cover. Based on studies of three-toed woodpeckers in the northwest, values associated with these features are as follows:

- Trees greater than 8 cm (3.15 in) are suitable for foraging or nesting, and trees greater than or equal to 20 cm (7.9 in) are optimal
- Tree heights greater than 4 m (13 ft) are suitable, and trees greater than or equal to 8 m (26 ft) are optimal
- Stands with numerous snags have more food and potential nests, and stands with greater than or equal to 1.2 snags/ha are optimal
- Conifer-dominated stands (more than 50% conifer) are preferred, and stands with more than 20% conifers are unsuitable
- Tree canopy closure must be more than 6% for a stand to be suitable for three-toed woodpeckers, and stands with closure greater than 50% are optimal

These habitat features may be applicable to New Hampshire and the rest of the Northeast, but use in this region should be done in conjunction with model testing and verification procedures (Zapisocki et al. 2000).

Information on average dbh, tree height, and snag density is generally unavailable on a wide scale in New Hampshire. Measures of percent of coniferous species coverage and percent canopy cover may be derived from aerial photos or from existing land cover analyses of aerial photos. Potential three-toed woodpecker habitat might be identified on a landscape scale by mapping currently and potentially disturbed habitats within conifer-dominated forests from the White Mountains north. Data needed for this landscape model might include:

- Land cover data to identify conifer-dominated stands
- Aerial photos of conifer dominated stands to determine % canopy closure and possibly % conifer cover. Aerial photos might also show disturbed habitats, especially standing dead trees
- Hydrology and National Wetland Inventory (NWI) maps to show wetlands and waterbodies, where this species is often found
- Current and potential beaver flowages, to show where flooding could cause tree mortality
- Topography and digital elevation models to show high wind areas where tree mortality may be caused by wind throw

1.7 Sources of Information

Information on historic and recent three-toed woodpecker distribution and habitat was found in breeding bird atlases from New York, Vermont, and New Hampshire, and from the three-toed woodpecker account of the Bird of North America series. Data on three-toed woodpecker observations were derived from the New Hampshire Audubon's New Hampshire Bird Records (NHBR) database. Other information was found in literature on three-toed woodpecker studies.

1.8 Extent and Quality of Data

There are very few data on three-toed woodpeckers in New Hampshire and in the Northeast in general. Their habitat is often remote and difficult to survey, and this species' relatively quiet behavior makes them challenging to detect.

1.9 Distribution Research

Surveys of historic sites and high-potential habitats would establish a baseline of information on current distribution and relative abundance of this species. Since this species occurs at all elevations, surveys could be coordinated with wetland bird surveys and high elevation bird surveys.

Element 2: Species/Habitat Condition

2.1 Scale

Three-toed woodpeckers have been documented the White Mountains, Lake Umbagog, and Pittsburg.

2.2 Relative Health of Populations

There are too few data to determine the relative quality of these sites, or the relative health of populations of this species. The most recent observations have occurred at East Inlet (Pittsburg) in 1998, Whaleback Ponds near Lake Umbagog (Errol) in 2004, and in the Presidential Range of the White Mountains in 2000. All of these areas are currently protected as either state or federal lands.

2.3 Population Management Status

Three-toed woodpeckers are not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

As mentioned in section 2.2, there is too little information on three-toed woodpeckers and their habitats to assess relative quality of sites. The conservation status of all known sites increases the probability that coniferous forest habitats will be managed to maintain or enhance habitat for this species.

2.5 Habitat Patch Protection Status

All of the known recent sites are protected. Two state agencies—the Department of Resource and Economic Development (DRED) and New Hampshire Fish and Game (NHFG)—own most of the town of Pittsburg, and East Inlet is within a large territory owned by the NHFG. Whaleback Ponds are within the Lake Umbagog National Wildlife Refuge, and the White Mountains are entirely within the White Mountains National Forest. Most of these areas will be exempt from logging activities and will eventually provide mature and old growth spruce stands suitable for three-toed woodpecker habitat.

High elevation spruce-fir habitats are almost completely protected in New Hampshire through a suite of regulations and agreements, including a no-cut zone above 2,700 ft on state, federal, and private conservation lands (the Bunnell tract and The Nature Conservancy). They are additionally protected by zoning ordinances (PD6 zones) in unincorporated towns, the cooperative High Elevation memorandum of understanding (MOU)OU for large landowners developed by NHFG and DRED, a conservation easement held by DRED, and an MOU between the WMNF and NHFG related to wildlife habitat management (J. Kelly in press).

These measures effectively protect most high elevation spruce-fir habitat. However, there is montane black spruce-red spruce habitat (2,500 to 3,000 ft) below 2,700 ft that may not be protected, as well as northern hardwood-spruce-fir forests from 2,100 to 2,800 ft that may still undergo timber harvests.

2.6 Habitat Management Status

None of these sites is being managed specifically for three-toed woodpeckers.

2.7 Sources of Information

Known sites were derived from NHBR, and conservation and management status was obtained from NHFG, the Umbagog National Wildlife Refuge, and the WMNF.

2.8 Extent and Quality of Data

There are few data on distribution and abundance of three-toed woodpeckers and no information on the availability and condition of suitable habitat for them.

2.9 Condition Ranking

2.10 Condition Assessment Research

Because three-toed woodpeckers are at the southern edge of their range in New Hampshire and occur in such scattered locations throughout the northern half of the state, it is probable that many suitable habitats are unoccupied simply because this species has not colonized them, or that they have not been detected. An assessment of the condition of known and potential habitat should incorporate data on spruce-fir patch size, stand age, tree dbh and height, canopy closure, and information on availability of large (greater than 25 cm (9.8 in) dbh) dead trees and snags.

Element 3: Species and Habitat Threat Assessment

3.1 Threats

See form 1: Threat Identification; form 2: Threat Ranking; and form 3: Local Threat Weighting (attached). Form 4 (Feasibility Ranking) for three-toed woodpecker will be the same as those for High Elevation Spruce Fir and Acadian Spruce Fir Forests. See the High Elevation Spruce Fir Forest and Acadian Spruce Fir Forest habitat profiles for a complete list of threats

3.1.1 Unsustainable Harvest (Forestry Operations and Management)

Timber harvesting is the most serious threat for high elevation and lowland spruce fir forests, and past and logging has reduced and degraded spruce-fir habitats throughout the state. Logging is a minimal threat to high elevation habitats today, but past harvesting activity will continue to affect the availability and condition of high elevation spruce-fir forests for many years.

Harvesting of lowland spruce-fir is still a threat, as stands are cut on relatively short rotations, eliminating the opportunity for forests to develop mature and over-mature stands on which three-toed woodpeckers depend. Increased fragmentation of forests, as well as more intensive management, has reduced the role of natural disturbances, such as fire, flooding, and insect outbreaks on forest structure and composition. Dead and dying timber is not marketable, and is often salvaged to clear a site for new growth. The loss of habitat for bark beetles and other insects results in a landscape that can not support three-toed woodpeckers or other species associated with mature and over-mature stands.

3.1.2 Mercury

Terrestrial and aquatic ecosystems are vulnerable to air-borne pollutants such as mercury and other heavy metals. High levels of mercury have been found in blood and tissues of many species of fish, mammals, birds and salamanders, all of which live in or are associated with wetlands, streams and other waterbodies. More recent research on forest songbirds in Vermont, however, indicates that insectivorous songbirds from high elevation spruce-fir forests to lower elevation deciduous woodlands are also accumulating high levels of mercury (Evers 2005). Deposition of mercury may be highest in certain high elevation sites, and mercury may accumulate in wetland habitats. Three-toed woodpeckers are often found in such areas and may therefore be vulnerable to mercury toxicity.

3.2 Sources of Information

Threats information for three-toed woodpeckers was derived from the literature and discussions with experts and colleagues during threat identification and ranking meetings. Habitat profiles and threat rankings for both high elevation and lowland spruce-fir habitats were used for the three-toed woodpecker threats analysis and were modified appropriately.

3.3 Extent and Quality of Data

Several studies on the effects of timber harvesting on three-toed woodpeckers have been conducted in Europe and the western United States and Canada. Although fewer studies have been done in the east, the results parallel those of research conducted elsewhere. There is very little information on the effects of development or human recreation on this species. Many observers suggest that three-toed woodpeckers are relatively unfazed by human presence, but there is virtually no information on the impacts of ski area development, hiking, timber harvesting, recreational vehicles, hunting, or other activities on this species.

3.4 Threat Assessment Research

Since there are few observations of three-toed woodpeckers in New Hampshire, priority research should focus on determining presence of this species at historic and recent breeding territories, followed by searches in likely potential habitats. This would provide baseline information on distribution and habitat selection, as well as breeding success and life history data.

Element 4: Conservation Actions

Three-toed woodpeckers are especially dependent on disturbed habitats within spruce-fir forests. Therefore, in order to provide sufficient habitat for this species, conifer-dominated stands in the White Mountains and northward should be managed to accommodate natural disturbances and patches of mature and over mature timber. Areas likely to be subject to high winds or beaver activity should be either left unmanaged or managed to leave large areas of standing dead trees. Sites affected by fire, insect outbreaks, or other disturbances should be managed similarly. Finally, sites that were originally spruce-fir and have grown back as hardwood-dominated stands should be managed to encourage conifer species.

Element 5: References

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5.2 Data Sources

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord, NH.

Element 6: List of Figures

Location (Town)	Date (s)
Tuckerman's Ravine (Sargent's Purchase)	1884, 1960s & 70s
Great Gulf Wilderness, Caps Ridge Trail, Jefferson Notch, Mt. Adams (Thompson & Meserve's Purchase)	1886, 1960s & 70s, 2000
Mt. Passaconaway (Waterville Valley)	1893
Umbagog Lake (Errol)	1890-1940, 2004
Mt. Starr King (Jefferson)	1890-1940
Carter Range (Bean's Purchase/Shelburne)	1890-1940
Greeley Ponds, Nancy Pond (Livermore)	1927, 1960-1981
East Inlet. Indian Stream (Pittsburg)	1952, 1954, 1980-1998
Mt. Webster (Hart's Location)	1960s & 70s
Kancamagus Pass (Livermore/Lincoln)	1960s & 70s
Mt. Clinton (Bean's Grant)	1960s & 70s
Avalon Trail (Bethlehem)	1981
Atlas block bog (Success)	1986
Isreal Ridge Trail, Mt. Adams (Low & Burbank's Grant)	1996

SPECIES PROFILE

Upland Sandpiper

Bartramia longicauda

Federal Listing: Not listed
State Listing: Endangered
Global Rank: G5
State Rank: S1
Author: Pamela D. Hunt and Diane De Luca, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Upland sandpipers occupy a wide range of grassland habitats. In the East, these include airfields, blueberry barrens (Maine), and mixed agricultural areas. The species needs a mix of short (less than 20 cm) and tall (up to 60 cm) grasses for foraging and nesting, respectively. Taller structures—such as fence posts, runway lights or signs, and taller forbs such as mullein—are needed for singing perches. Upland sandpipers avoid grasslands with high densities of legumes or with a dense litter layer (Carter 1992, Houston and Bowen 2001).

Upland sandpipers require large areas of grassland for breeding. Ideally, such fields should be over 60 ha (150 acres), and even fields as large as 120 ha (300 ac) may not necessarily support the species (Carter 1992, Vickery et al. 1994). Territories average 8 to 12 ha (20 to 30 ac), and the species is often loosely colonial where it reaches higher densities (Carter 1992). Sites used by sandpipers in New Hampshire include large airfields (Pease, Manchester, Nashua) and large agricultural mosaics (Dover, Rochester, Haverhill).

1.2 Justification

The upland sandpiper has always been rare in New Hampshire. It probably did not occur in the state until the 1800s, after forest clearing allowed it to expand eastward from the Midwest (Foss 1994). It was primarily limited to major river valleys and coastal plain, where it occasionally reached high densities. Population declines in New Hampshire began as early as 1900 (Foss 1994), although detailed data are lacking. As recently as the early 1980s, upland sandpipers still bred in at least 5 locations (Foss 1994, figure 1), although there were fewer sightings of migrating birds (NHBR, figure 2.). Breeding has only been confirmed at the Pease Airfield in Portsmouth and Newington (with at least one confirmed breeding event just off the airfield at the Great Bay National Wildlife Refuge), although sightings from Dover, Manchester, and southern Coos County in the last decade (figure 1) imply that birds are still visiting appropriate habitat elsewhere in the state.

The upland sandpiper is of conservation concern throughout the Northeast. Many historic habitats in New England were on large dairy farms, and these have been gradually disappearing (A. Jones, personal communication). Over the range as a whole, Breeding Bird Survey data indicate an insignificant increase of 0.8% per year from 1966, but a 1.2% annual decline since 1980. In the Northeast, the corresponding values are both declines: 0.4% since 1966 and 1.7% since 1980 (Sauer et al. 2004). The steeper declines since 1980 coincide with the period of greatest decrease in the New Hampshire breeding population.

1.3 Protection and Regulatory Status

This species is protected at the federal level by the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs. The New Hampshire Endangered Species Conservation Act (RSA 212) protects upland sandpipers in New Hampshire.

1.4 Population and Habitat Distribution

From the 1960s onward, most of New Hampshire's upland sandpipers have occurred in 3 areas of the state: 1) the upper Connecticut River Valley (Haverhill through Northumberland), 2) the Merrimack Valley from Plymouth southward, and 3) the seacoast (figure 1). Specific locations where sandpipers have been recorded since 1980 are presented in table 1.

Only a small proportion of the continental upland sandpiper population occurs in New England, which supports roughly 250 breeding pairs. The majority of these (150 pairs) breed in eastern Maine, with another 50 to 60 pairs at Westover Air Force Base in western Massachusetts (Jones et al. 2001). New Hampshire's share of the regional population is thus extremely small.

1.5 Town Distribution Map
Not completed for this species.

1.6 Habitat Map
N/A

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Data on upland sandpiper distribution in New Hampshire were compiled from NHBR and reports on breeding surveys at the Pease Airfield.

1.8 Extent and Quality of Data

The combination of an active amateur birder population and systematic grassland bird surveys over the last decade makes it unlikely that breeding sandpipers would have been overlooked in southern New Hampshire. However, the historic breeding areas in the upper Connecticut River valley have not been well surveyed, and recent records from Lancaster and Whitefield suggest that a small population may persist somewhere in the north.

1.9 Distribution Research

A comprehensive survey of suitable habitat in the upper Connecticut River valley and lower Merrimack River valley is needed. Observers should search for the species in Haverhill, in the extensive grasslands in the Lancaster area, and at the Manchester Airport. Surveys should broadcast sandpiper vocalizations during the breeding season. Such research should reach out to farmers and local residents in areas where suitable habitat remains to inform people of the species' rarity and distinguishing characteristics, and encourage data reporting.

Element 2: Species Condition

2.1 Scale

Given the severely restricted current distribution (1 site), the best approach to conservation of this species in the state should focus on 4 units:

- Pease Airfield and vicinity
- Agricultural lands in southern Strafford County (especially Durham, Dover, Rochester)
- Lower Merrimack River Valley (especially Manchester Airport)
- Upper Connecticut River Valley (Haverhill to Lancaster)

2.2 Relative Health of Populations

The only population in New Hampshire occurs at the Pease Airfield in Portsmouth and Newington. This population has been monitored regularly since 1989 and has averaged 8 to 12 pairs during the period (figure 3). This population has produced a minimum of 10 to 15 chicks in most breeding seasons, although surveys have not always been comprehensive. Since 1990, single birds or pairs have appeared in nearby areas of Newington (table 1), suggesting that dispersing individuals occasionally settle in suitable habitat away from the airfield. Populations that once consistently occupied sites in Haverhill and Manchester were last recorded in 1984 and 1985, respectively, although the species was reported at the Manchester Airport in 1999. Since 1985, only 5 sites other than Pease have supported upland sandpipers for more than a year, and even in those cases there was little evidence of breeding activity.

2.3 Population Management Status

No management specific to this species—other than periodic monitoring—is currently occurring in New Hampshire. See Section 2.6 for details on habitat management at the only occupied site.

2.4 Relative Quality of Habitat Patches

The 4 units identified in section 2.1 vary in type of land use, development pressures, and habitat management. At the Pease Airfield, sandpipers are being managed (see section 2.6). Sandpipers are not being managed in adjacent areas of Newington, where occupancy is irregular. Strafford County agricultural lands are at greater threat from development, and because they are closer to the species' core range, they probably represent better potential habitat. The Manchester Airport has an extensive area of suitable habitat, but security and safety concerns have so far made it impossible even to determine the extent of sandpiper use at this site, much less implement management beneficial to the species. Finally, the northern agricultural areas are at somewhat lower risk from habitat conversion than those near the seacoast. In all areas, any assessment of habitat quality will need to consider both the composition (i.e., mix of grass heights) and size of available fields as discussed in section 1.1.

2.5 Habitat Patch Protection Status

With the exception of the Weapons Storage Area at the Great Bay National Wildlife Refuge, none of the breeding areas identified above are protected. A memorandum of understanding is in place at the Pease Airfield (see section 2.6).

2.6 Habitat Management Status

Starting in the 1990s, several entities cooperated to manage upland sandpiper habitat at the Pease Airfield. The resulting mowing regime meets airport safety regulations and protects sandpipers during vulnerable early stages of nesting (incubation and pre-flight chick). Mowing of safety areas begins by 1 May to discourage nesting attempts, and no other areas of the airfield are mowed until after 31 July (De Luca 2002). Airport personnel are regularly informed of active nesting areas (when monitoring is being done) so that disturbance is minimized. Although a fence surrounding the habitat discourages large mammals from approaching the runway, sightings of fox and coyote have increased (De Luca 2002). Given that these species pose a predation risk to sandpipers, there may be need to reconsider predator control at this site.

The Great Bay National Wildlife Refuge is managing its grassland areas, including the weapons storage area where sandpipers have recently bred. Management includes mowing and burning to maintain grassland, and such activities are not done until after the breeding season.

At the Strafford County Farm in Dover, there is an agricultural lease agreement covering the years 2003 to 2008. This agreement includes the following provisions beneficial to grassland birds:

- Delayed mowing in wetter areas
- Raise mowing bar to 6 inches or more in areas with grassland bird concentrations
- Attach flushing bars to the front of mowers
- Avoid night mowing
- 16 acres have been set aside as a reserve, and will not be mowed until after 1 August
- If upland sandpipers are found on the farm, an un-mowed buffer should be established around the occupied area

2.7 Sources of Information

Summaries of population health were based on data from NHBR and reports of upland sandpiper monitoring produced by NHA. Details of management practices at the Pease Tradeport and Strafford County Farm were taken from management agreements for those 2 locations.

2.8 Extent and Quality of Data

With the exception of Pease Airfield, data are largely lacking for all areas of the state. Even there, current monitoring intensity may not be sufficient to detect productivity or to determine what factors may be responsible for recent population declines.

2.9 Condition Assessment Research

Increased sightings of potential predators at the Pease Airfield suggest that predator monitoring may need to be implemented. Since Pease is the only known population of upland sandpipers in the state, it is especially important to understand the quality of this site for breeding sandpipers. In addition, no studies of the actual grassland habitat at Pease have been conducted since the original Pease Air Force Base was decommissioned in 1990. An assessment of current habitat condition at this site could be valuable in guiding future management activity.

Element 5: References

5.1 Literature

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Sauer, J.R., J.E. Hines, and J. Fallon. 2004. The North American Breeding Bird Survey, Results and Analysis 1966-2003. Version 2004.1, USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA.

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Zeranski, J.D., and T.R. Baptist. 1990. Connecticut Birds. University Press of New England, Hanover, New Hampshire, USA.

5.2 Data Sources

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord, NH.

Element 6: List of Figures

Figure 1. Distribution of breeding season (late May-July) records of upland sandpiper in New Hampshire 1965-2004. Towns are coded according to the number of years in each period when sandpipers were reported: yellow = 1, red = 2-5, black = > 5 (data from NHBR and De Luca 2002). Records of birds in late May but not later in the season are excluded as being possible migrants unless they were reported from a site with a consistent pattern of use by the species.

Figure 2. Number of reports of migrant upland sandpipers in spring (April-May) from 1965-2004. For each five-year period, all year/location records have been combined. Migrant reports from the Pease

Airfield are not included in this analysis.

Figure 3. Numbers of upland sandpipers at the Pease Airfield, 1989 to 2004. Values represent the mid-point of the range given for numbers of pairs in a given year. Systematic surveys were not conducted in 2000 and 2001.

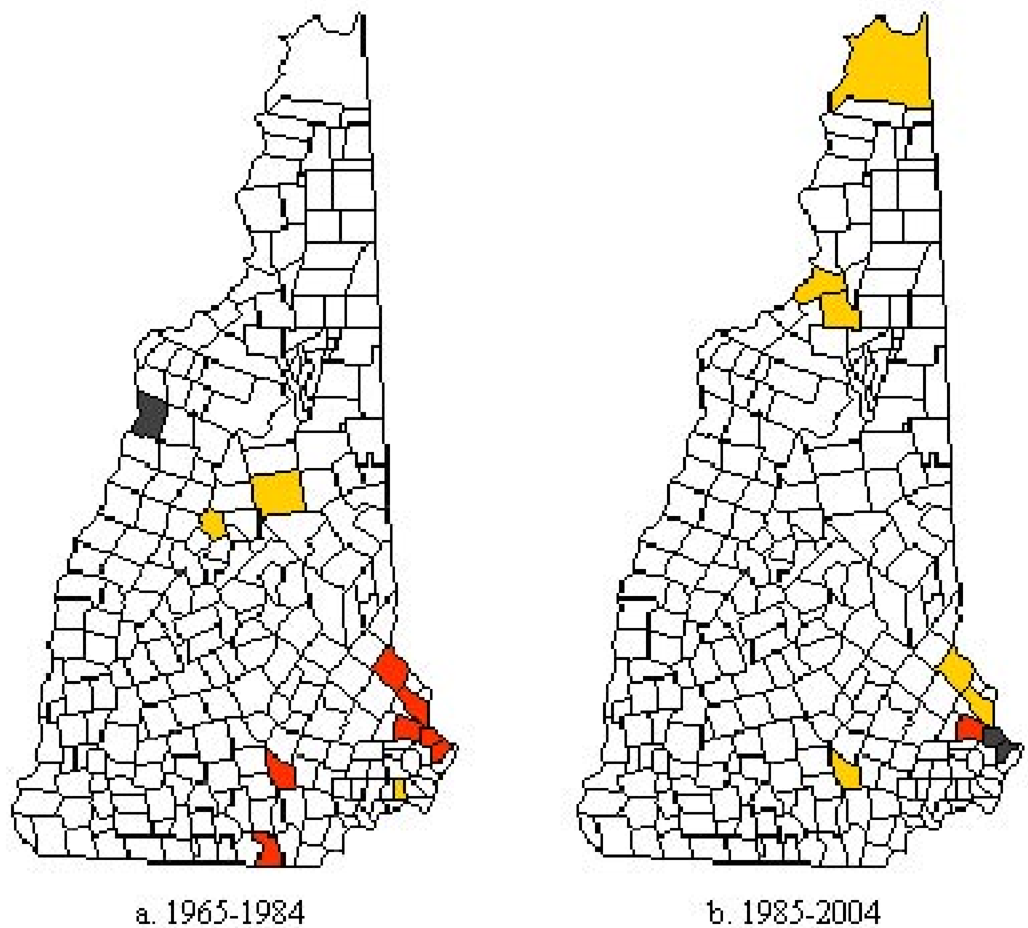

Figure 1

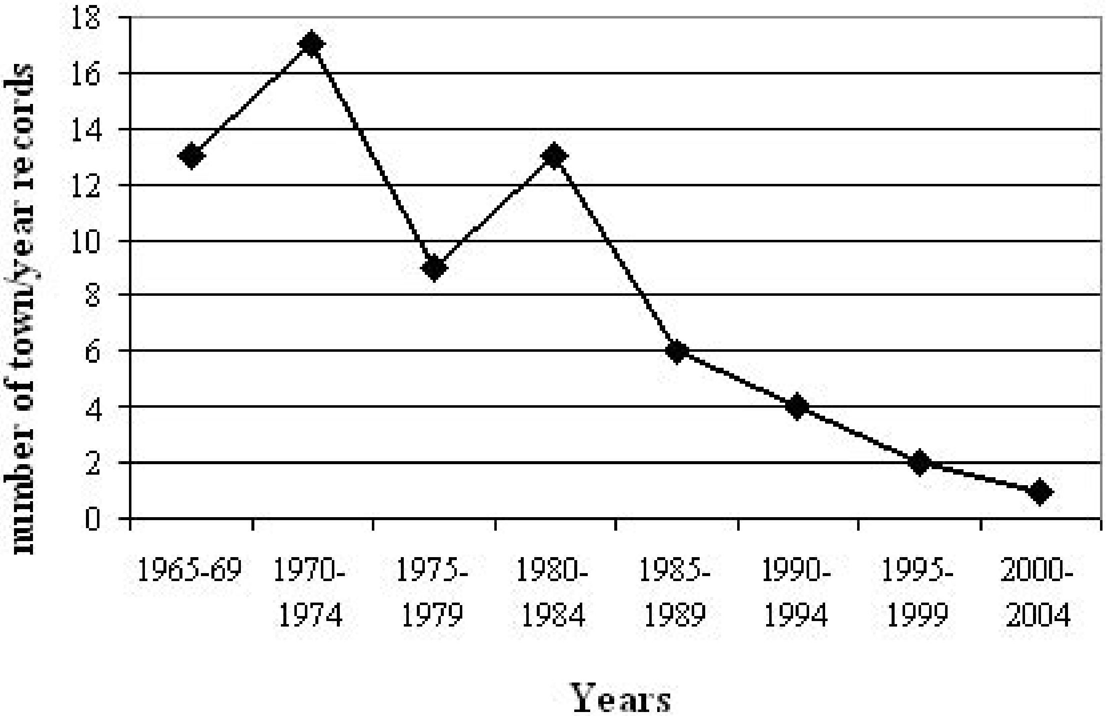

Figure 2. Number of reports of migrant upland sandpipers in spring (April-May) from 1965-2004. For each five-year period, all year/location records have been combined. Migrant reports from the Pease Airfield are not included in this analysis.

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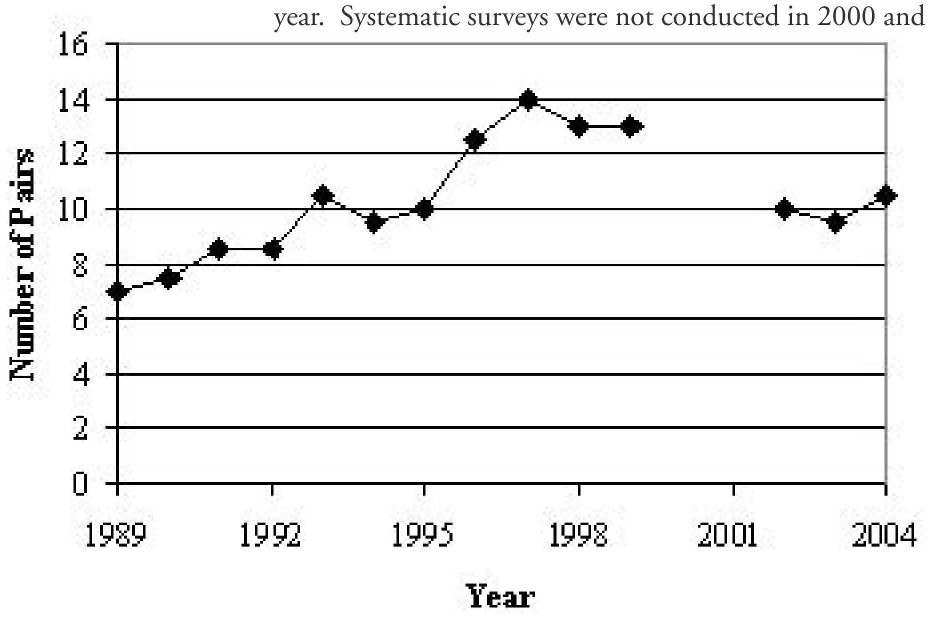

SPECIES PROFILE

Vesper Sparrow

Pooecetes gramineus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S2S3B
Author: Alina, J. Pyzikiewicz, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

The breeding habitat of the vesper sparrow consists of dry, open grassy areas with patches of bare ground and elevated perching areas. Such habitat includes old fields, crop and hayfields, cemeteries, and airports (Janeway 1994, Jones and Cornely 2002). Nests are built adjacent to woodlands and are concealed in small depressions on the ground and covered by vegetation or wood debris (Janeway 1994, Jones and Cornely 2002). The vesper sparrow forages on the ground, feeding on insects, grasshoppers, and caterpillars during the breeding season, and on grains and seeds all year long (Janeway 1994, Jones and Cornely 2002). Wintering habitats include grasslands, weedy fields, and other natural or cleared openings with sparse shrubby vegetation (Jones and Cornely 2002).

1.2 Justification

Development, reforestation, the decline of farmland, and agricultural practices such as mowing, have all led to the decline of the vesper sparrow throughout its range (Vickery et al. 1999, Jones and Cornely 2002). Breeding Bird Survey data (1966 to 2004) for New Hampshire show that the vesper sparrow is limited to 160 individuals and is declining at an annual rate of 13%. Grassland bird surveys between 1997 and 2000 by the Massachusetts Audubon Society counted only 11 (Jones et al. 2001, USGS Patuxent Wildlife Research Center 2005).

1.3 Protection and Regulatory Status

The vesper sparrow is protected under the Migratory Bird Treaty Act and through various grassland bird conservation programs (North American Bird Conservation Initiative, Partners in Flight Northeast Grassland Bird Working Group).

1.4 Population and Habitat Distribution

The range of the vesper sparrow extends from southern Canada to central Mexico (Ridgely et al. 2003). Breeding range includes southern Canada and the central United States, and wintering range includes the southern United States and central Mexico (Ridgely et al. 2003). In New Hampshire, the vesper sparrow can be found breeding in isolated pockets of open grasslands (airports, hayfields, power line right of ways) south of the White Mountains region (NHNHB 2005).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

N/A

1.7 Sources of Information

Sources of information include the NHNHB Database, New Hampshire Breeding Bird Atlas, Janeway (1994), and Jones and Cornly (2002).

1.8 Extent and Quality of Data

Vesper sparrow habitat and population distribution is well studied throughout its range, but population data in New Hampshire are limited.

1.9 Distribution Research

- Identify key grassland habitat areas
- Continue monitoring grassland habitats to better assess vesper sparrow abundance trends
- Conduct productivity and survival studies to provide information needed for determining causes of population declines
- Determine effects of agricultural management on populations that occur in such habitats

Element 5: References

5.1 Literature

Janeway, E.C. 1994. Vesper sparrow. Pages 318-319 *in* Breeding bird atlas of New Hampshire, C.R. Foss, editor. Arcadia, Dover, New Hampshire, USA.

Jones, S.L, and J.E. Cornley. 2002. Vesper sparrow (Pooecetes gramineus). *In* The Birds of North America, No 624, A. Poole and F. Gill, editors. The Birds of North America, Philadelphia, Pennsylvania, USA.

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5.2 Data Sources

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SPECIES PROFILE

Whip-Poor-Will

Caprimulgus vociferous

Federal Listing: Not listed
State Listing: Special concern
Global Rank: G5
State Rank: S3B
Author: Pamela D. Hunt, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Whip-poor-wills inhabit areas of dry soils and open understory, especially in pine and oak woodlands (Clink 2002). They prefer to forage in open areas, such as fields, clearings, regenerating clear cuts, recent burns, and power line rights of way (Wilson 2003). Dry soil, which contributes to the sparse understory that whip-poor-wills prefer, may also allow for better drainage of the leaf litter where the birds lay their eggs. However, definitive data are lacking.

In New Hampshire, whip-poor-will records during the Breeding Bird Atlas were all from areas below 1,200 ft in elevation (Foss 1994), a pattern consistent with the species' distribution in New York (Andrle and Carroll 1988) and Vermont (Laughlin and Kibbe 1985). During a study in the Piscataquog River Watershed in 2003, whip-poor-will records were concentrated in the northeastern quarter of the watershed. A preliminary analysis of habitat at points where whip-poor-wills were detected suggests that birds were more likely to occur in areas identified by aerial photography as "dry pine forest," "gravel pit," or "disturbed" (photo interpretation by D. Sundquist, SPNHF).

1.2 Justification

Anecdotal accounts over much of the Northeast suggest a consistent decline in whip-poor-will populations, including in Vermont (Laughlin and Kibbe 1985, Murin and Pfeiffer 2003), New Hampshire (Foss 1994), Massachusetts (Veit and Petersen 1993, Petersen and Meservey 2003), Connecticut (Zeranski and Baptist 1990), and southern New Jersey (Sibley 1993). In New York, the current Breeding Bird Atlas indicates a dramatically reduced range compared to the years from 1980 to 1985 (New York Department of Environmental Conservation 2004). These declines are corroborated by data from the Breeding Bird Survey (BBS), which indicate significant declines in both the Northeast (USFWS region 5) and the eastern third of the continent (Sauer et al. 2004).

Because the BBS does not survey nocturnal species particularly well, these trends should be viewed with some caution, although other data also suggest long-term declines. Whip-poor-will is on the priority species lists in the CWCS for every state in Bird Conservation Region (BCR) 30 (New England/mid-Atlantic Coast), and it ranks moderate-to-high concern in other BCRs within its range. Although specific data are unavailable for New Hampshire, NHBR (see section 1.4) and anecdotal accounts make clear a range retraction from the northern and coastal areas.

1.3 Protection and Regulatory Status

This species is protected under the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs.

1.4 Population and Habitat Distribution

In New Hampshire, whip-poor-wills have historically been most common south of the White Mountains (Foss 1994, and references therein). The northern edge of its distribution during the early 1980s corresponded fairly well with the 68 degree July isotherm. North of this line, there were more records in the western highlands than in the White Mountains and areas to the north. Concentrations during the Breeding Bird Atlas occurred in central Carroll County in the Ossipee area, in a band from northwest Merrimack County to north-central Hillsborough County, and in central Strafford County (Foss 1994). In addition to the Atlas, the NHA conducted a statewide volunteer whip-poor-will survey program from 1980 to 1985. Data from this program indicate a range very similar to that indicated by the Atlas: concentrations in northern Carroll, Merrimack, eastern Hillsborough, Strafford, and central Rockingham Counties (figure 1a).

Recent data (NHBR) suggest that this range had not changed dramatically by the early 1990s (figure 1b) or early 2000s (figure 1c), although there is some indication of range retraction in the north and near the seacoast. It should be noted, however, that no standardized survey was in place during this period. Nonetheless, anecdotal data from throughout the state indicate a consistent decline, one that has apparently been going on since at least the early 1960s (Foss 1994).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

N/A

1.7 Sources of Information

Basic natural history information in this profile was largely gathered from the literature cited in element 5. Data on whip-poor-will distribution in New Hampshire were compiled from NHBR, a database maintained by the NHA.

1.8 Extent and Quality of Data

Because whip-poor-wills are largely nocturnal, there are limited data on their demographics in New Hampshire. Most data are anecdotal, and even during the intensive Breeding Bird Atlas the species almost certainly went undetected in many areas. When surveys specific to this species were implemented in the Ossipee and Piscataqua River watersheds in 2003 and 2004, observers found the species quite common in some areas. This recent data should not be taken as evidence that the perceived decline is less extreme, only that overall populations are likely to be underestimated by anecdotal accounts. Given that the number of anecdotal accounts has been on the decline, it is safe to conclude that the species may be decreasing in the state and region (if the number of observers has not also declined).

1.9 Distribution Research

Northeast Partners in Flight has identified nightjar monitoring as a priority. Because whip-poor-wills and other nightjars are poorly surveyed by traditional methods like the BBS, there is need for standardized monitoring protocols to be implemented across the region, if not the entire range. Implementation of such surveys in New Hampshire—which would build upon monitoring initiated in 2003—is critical to determine the distribution and abundance patterns across the state. When conducted for several years, such a program will also provide valuable information on population trends. Data can then be used for habitat conservation or species-specific research.

Element 2: Species/Habitat Condition

2.1 Scale

Although there are areas where whip-poor-wills appear more concentrated in the state (Ossipee Pine Barrens, Merrimack and Hillsborough Counties), the lack of consistent statewide data makes it impossible to evaluate these putative concentrations. Because whip-poor-wills are not restricted to pine barrens habitats, it is similarly impractical to identify planning units based on habitat. As a result, all discussion of whip-poor-will conservation will treat the species' entire range as a single unit, with the recognition that certain habitats within this distribution will be divided into planning units. Whip-poor-will conservation can occur on a statewide scale as described in this profile, or within smaller units identified for specific habitats in which whip-poor-wills occur.

2.2 Relative Health of Populations

Based on the available data, statewide whip-poor-will populations are declining. Data from historic strongholds (Ossipee, Merrimack/Hillsborough) suggest that the species remains common in these areas, although there are no comparable baseline data on abundance prior to 2003.

2.3 Population Management Status

Whip-poor-will populations are not currently managed in New Hampshire.

2.4 Relative Quality of Habitat Patches

In the absence of detailed data on habitat needs, it is not feasible to assess quality of whip-poor-will habitat at most scales. To the extent that habitat continues to be lost to development, succession, or fire suppression (see element 3), overall habitat quality is likely to continue to decline in most areas.

2.5 Habitat Patch Protection Status

Because whip-poor-wills remain widespread in the southern part of the state, and because specific locations are not determined (most records are of heard birds, often at some distance), an analysis of protection status is not possible. One could approximate this number by calculating the percent of the species' statewide range (south of 68 degree July isotherm plus western highlands) that is protected. However, this number would not reflect the patchy distribution of whip-poor-wills within the potential range.

2.6 Habitat Management Status

Habitat management specifically to benefit this species is not occurring anywhere in New Hampshire. However, ongoing attempts to restore or mimic fire in pine barrens would likely benefit whip-poor-wills, which have been documented concentrating in recently burned areas in southeastern Massachusetts (J. Kelly, United States Army – Fort Edward, personal communication). See the pine barrens habitat profile for more detail on habitat management issues.

2.7 Sources of Information

Information on whip-poor-will distribution in New Hampshire was obtained primarily from NHBR and was supplemented by historical accounts and recent surveys.

2.8 Extent and Quality of Data

See Section 1.8.

2.9 Condition Assessment Research

As discussed in section 1.9, coordinated whip-poor-will monitoring is needed before any attempt can be made to fully assess habitat condition. If areas of high concentration are discovered, detailed studies should be conducted to determine what makes the habitat attractive to whip-poor-wills.

Element 3: Species Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

Because the bulk of New Hampshire's whip-poor-will population occurs in the rapidly developing southern part of the state, the species is at high risk of losing habitat to development. At the same time, the pine barrens and other dry forests preferred by the species are usually located in river valleys and near lakes where development pressure is particularly intense.

3.1.2 Altered Natural Disturbance (Natural Succession)

(A) Exposure Pathway
Because of ongoing declines in agriculture (see grassland habitat profile), many open areas adjacent to forests are either growing up to shrubland or young forest or are being lost to development (section 3.1.1). Although early successional habitat may remain somewhat open for several years, it will eventually revert to forest if not managed.

(B) Evidence
Because whip-poor-wills require openings in which to forage, loss of fields or other early seral stages are believed to lower habitat quality (Cink 2002, Wilson 2003). If the amount of open habitat is reduced to the point where foraging efficiency is reduced, whip-poor-wills may no longer occupy the area even if nesting habitat remains suitable (Cink 2002).

3.1.3 Predation and Herbivory

(A) Exposure Pathway
Several authors (e.g., Laughlin and Kibbe 1985, Cink 2002, Petersen and Meservey 2003) have speculated that whip-poor-will declines are related to a decline in prey populations. In particular, it has been proposed that saturnid and sphingid moth populations over much of the Northeast were severely depressed following widespread spraying for the introduced gypsy moth (*Lymantria dispar*) from roughly 1950 to 1970. Any subsequent recovery of moth populations is believed to have been hampered by a parasitoid fly (*Compsilura concinnata*), which was introduced to combat gypsy moths (Schweitzer 2004). An alternate hypothesis is that moth declines are the result of atmospheric pollution (Andrele and Carroll 1988).

(B) Evidence
There are limited data on the nature and extent of moth declines in eastern North America where most gypsy moth control has occurred. Thus, any connection between large moth populations and whip-poor-will populations is largely speculative. Data on diet indicate that almost 60% of prey items are moths (Cink 2002), which at least corroborate the species' reliance on this group of insects.

3.1.4 Altered Natural Disturbance (Fire Suppression)

As per threat 3.1.1, this issue will be dealt with in the context of pine barrens habitat as a whole.

3.2 Sources of Information

Information used in this section was obtained primarily through a literature review.

3.3 Extent and Quality of Data

For threats related to habitat loss and maturation, there are generally extensive data on extent but relatively few data pertaining to effects on whip-poor-wills (see section 3.4). Data are even more lacking for hypotheses about declines in whip-poor-will prey populations.

3.4 Threat Assessment Research

Data are needed on habitat use patterns of whip-poor-wills throughout their range, although studies of this nature are currently underway in Massachusetts (J. Kelly, United States Army – Ft. Edward, personal communication). There are even fewer data linking declines in prey populations to whip-poor-will declines, and any study of this threat would need to monitor populations of prey insects and their parasitoids. Finally, there are few studies of whip-poor-wills on their winter grounds in Florida and Central America (Cink 2002), and one should not discount the possibility that habitat loss, pesticide use, or other factors operating during the non-breeding season are affecting whip-poor-will populations. The widespread range retraction over much of the Northeast could be an indication that non-local factors (i.e., during the non-breeding season) are affecting populations on a larger scale.

Element 4: Conservation Actions

In the absence of more data on how threats affect whip-poor-will populations in New Hampshire, it is not possible to identify species-specific conservation actions. Whip-poor-wills will likely benefit from any action, whether land protection or habitat restoration, that targets the pine barrens and other forested habitats in which they occur. In both habitats, it will be important to consider the species' need for openings and edges for foraging, and when possible plan to maintain core habitats in a mix of seral stages.

Element 5: References

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5.2 Data Sources

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SPECIES PROFILE

Willet

Catoptrophorus semipalmatus

Federal Listing: Not listed
State Listing: Special concern
Global Rank: G5
State Rank: S3B
Authors: Megan McElroy and Kimberly Babbitt, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

Willets inhabit salt marshes, or grass-dominated tidal wetlands existing in the transition zone between ocean and upland (Niering and Warren 1980) (see Salt Marshes habitat profile). In New Hampshire, willets breed in large salt marshes dominated by *Spartina* grasses (Gavutis 1994, Lowther et al. 2001). Willets forage in sparsely vegetated *Spartina* grasses, along tidal creeks, at salt marsh edges, and at mussel beds and mudflats near salt marshes (Lowther et al. 2001). Their diet consists primarily of crustaceans, mollusks, polychaetes, and adult and larval insects (Lowther et al. 2001).

1.2 Justification

In New Hampshire, the willet is identified as a species of special concern. Little data exist on willet population trends, estimates, and threats in the state, and no long-term studies of the species have been conducted in New Hampshire. Loss and degradation of salt marshes are probably the most pressing threats to willet populations in New Hampshire. High-quality salt marsh habitat must be available in large patches across a landscape to support a population's survival and growth. Degradation and loss of salt marsh habitat caused by tidal restrictions have resulted in the replacement of typical salt marsh vegetation with invasive reeds and grasses, such as cattails and common reed (Sinicrope et al. 1990, Burdick et al. 1997, Brawley et al. 1998). Areas of invasive plants in and around salt marshes decrease available habitat for willets because they are not suitable habitat.

The lack of knowledge of population sizes and threats in New Hampshire is similar for other salt marsh nesting birds, such as salt marsh sharp-tailed sparrow and seaside sparrow. Research and monitoring of this salt marsh guild may indicate marsh health and provide insight into effects of marsh degradation and outcomes of restoration and other management practices.

1.3 Protection and Regulatory Status

- The Migratory Bird Treaty Act of 1918 legally protects willets from the take, transport, and use of the species (including eggs, nests, and feathers).
- Salt marsh habitat is regulated by NHDES. Activities that may involve filling, dredging, or destroying wetlands are strictly regulated and require approved permits before work can commence (RSA 482-A).

1.4 Population and Habitat Distribution

Eastern willets (i.e., the eastern subspecies) breed in coastal wetlands along the Atlantic and Gulf coasts (Lowther et al. 2001). In New Hampshire, willets breed in large salt marshes (Gavutis 1994, NHBR, McElroy and Babbitt, unpublished data). While willets may use any of these marshes as migratory habitat, breeding occurs in Hampton and Seabrook salt (NHBR, McElroy and Babbitt, unpublished data).

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

A literature review was conducted to obtain willet habitat, population distribution, and status data. Historical information on the distribution of willets in New Hampshire comes from NHA's database of bird records. Information on current population distribution and status comes from data collected in 2004 by researchers from UNH.

1.8 Extent and Quality of Data

Historical bird records from NHA are sightings reported by birders. Although this information is vital to knowledge of historical distribution, it does not give an accurate account of population size or confirmed breeding locations throughout the state. The most comprehensive dataset comes from UNH researchers and includes confirmed breeding locations and population estimates throughout the state. Although this dataset is extensive, it covers only one year. Therefore, significant gaps exist in understanding of willet breeding populations throughout the state, and long-term trends in population locations and sizes in New Hampshire are unknown.

1.9 Distribution Research

To determine willet distribution in New Hampshire, a long-term survey of salt marsh habitat specifically for willets (i.e., point counts conducted during breeding season at established points) is needed in conjunction with regional efforts. It is essential that monitoring is long term because salt marsh habitat quality changes, potentially affecting willet populations from one breeding season to the next.

Element 2: Species/Habitat Condition

2.1 Scale

The New Hampshire conservation unit for the willet is Coast (including Rye, Hampton, and Seabrook)

2.2 Relative Health of Populations

In New Hampshire, the willet population during the breeding season is estimated at 100 individuals (McElroy and Babbitt, unpublished data). Because a sufficient long-term survey of willets has not been implemented and Breeding Bird Survey routes do not sufficiently cover salt marshes, data on population trends are not available. In 2004, a complete survey focused on the presence and abundance of willets at all potential breeding sites in New Hampshire's salt marshes (McElroy and Babbitt, unpublished data).

Data from the 2004 breeding season showed willet activity at the following sites, grouped by breeding category (Confirmed Breeding = nest(s) found; Possible Breeding = adults present throughout season, calling & territorial behavior, no evidence of nests and/or fledglings; Potential Breeding = a few birds present feeding at some point in the season, no evidence of any current breeding activity) (table 1). Estimated Relative Abundance (ERA) categories are also included.

2.3 Population Management Status

New Hampshire currently has no ongoing population management efforts for willets. The large marsh complex in Hampton contains all known breeding and possible breeding populations. Therefore, this location should be a priority for any conservation actions. In particular, the marsh off Route 1A between Routes 101 and 101E is an important breeding site for willets.

2.4 Relative Quality of Habitat Patches

In New England, willets breed in large, unrestricted, *Spartina*-dominated marshes with nearby foraging areas (Gavutis 1994, Lowther et al. 2001, McElroy and Babbitt, unpublished data). Most marshes along the coast in Hampton, Rye, and Seabrook potentially have the key ecological attributes (e.g., migratory or nesting habitat), but more research is needed to better understand the marshes' habitat quality for willets.

2.5 Habitat Patch Protection Status

See Salt Marshes habitat profile

2.6 Habitat Management Status

See Salt Marshes habitat profile

2.7 Sources of Information

A literature review provided information on research and habitat management. Research by UNH scientists provided an assessment of population and management status. Information on habitat protection and management came from the New Hampshire Coastal Program's website and published articles on habitat restoration.

2.8 Extent and Quality of Data

The most extensive dataset comes from researchers at UNH. It includes confirmed breeding locations and population estimates throughout the state. However, this dataset covers only one field season. An adequate assessment of population health and habitat suitability would require a long-term study. Significant gaps exist in understanding of willet populations and the effects of habitat restoration in New Hampshire.

2.9 Condition Assessment Research

Long-term monitoring of willet populations is essential for knowledge of population dynamics, trends, and ecology. It would provide valuable data to increase understanding of threats to the species and the effects of habitat management efforts.

To determine population abundance at sites of known use (and therefore, a more accurate assessment of marshes of high protection/conservation priority), in-depth monitoring of the breeding population (in addition to point count surveys) is needed. This species is territorial, so point count surveys and similar methods can be used effectively to estimate population abundance and potential breeding sites.

Additionally, a long-term dataset of presence/absence and abundance estimates at marshes throughout New Hampshire would allow development of a GIS map showing locations with high densities of breeding willets. The maps would help target hotspots for research, conservation, and habitat protection.

Element 3: Species Threat Assessment

3.1.1 Development (Habitat Loss)

(A) Exposure Pathway
See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

(B) Evidence
Habitat loss is a significant factor in the decline of wetland birds that depend on salt marshes for nesting (Greenlaw and Rising 1994, Benoit and Askins 1999). Habitat loss could potentially affect willet population size; Shriver et al. (2004) found that occurrences of willets in the Gulf of Maine correlated with marsh size and proximity to other marshes. In Connecticut, willets were present only in marshes larger than 138 hectares (Benoit and Askins 2002). Therefore, continued habitat loss due to development pressures is likely to negatively affect willet populations in New Hampshire.

3.1.2 Development (Fragmentation)

(A) Exposure Pathway
See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

(B) Evidence
Willets are considered area-sensitive species, and populations could be negatively impacted by habitat fragmentation and decreasing patch size. In Connecticut, willet densities exhibited a positive relationship with marsh area (Benoit and Askins 2002).

3.1.3 Altered Hydrology (Tidal Restriction)

(A)Exposure Pathway
See Sharp-tailed Sparrow profile

(B) Evidence
Vegetative composition and structure are important components of willet ecology. Willets build nests along edges of salt marshes in smooth cordgrass, salt hay grass, or on wrack in the high marsh (Lowther et al. 2001, McElroy and Babbitt, unpublished data). However, brackish species and invasive plant species tend to replace salt marsh grasses in tidally restricted marshes (Niering and Warren 1980, Benoit and Askins 1999). Salt marshes with severe tidal restrictions lack quality nesting habitat for willets (Lowther et al. 2001).

3.1.4 Introduced Species (Introduced Plants)

(A) Exposure Pathway
See Sharp-tailed Sparrow Profile

(B) Evidence
Dense, monotypic stands of common reed provide unsuitable or less-preferable habitat and food for many wildlife species (Roman et al. 1984). Willets are normally found in *Spartina* spp. grass and are unlikely to use a marsh dominated by tall, thick stands of common reed or cattails. According to Benoit and Askins (1999), the presence of smooth cordgrass at a site was a significant predictor for the abundance of willets. Willets were absent from survey plots with mixed brackish vegetation, cattail, and common reed (Benoit and Askins 1999).

3.1.5 Altered Hydrology (Mosquito Ditching)

(A) Exposure Pathway
See Sharp-tailed Sparrow profile

(B) Evidence
Mosquito ditching reduces the abundance of cordgrass, an essential habitat feature for breeding willets, by draining standing water on the marsh surface (Benoit and Askins 1999, Lowther et al. 2001). Drier, ditched marshes may not provide quality nesting habitat or a sufficient abundance of invertebrates and therefore are less suitable for willets (Lowther et al. 2001). In addition, the lower water levels and the resulting invasion of bushes and brackish plants along ditch banks increases predators' access to the marsh (Post and Greenlaw 1994).

3.1.6 Mercury, Non-Point Source Pollution

See Sharp-tailed Sparrow profile

3.2 Sources of Information

Information on threats to willets was obtained from a literature review, New Hampshire Coastal Program, NHNHB, and Biodiversity Research Institute in Gorham, Maine.

3.3 Extent and Quality of Data

On a regional level, threats to willets have gained significant attention from researchers and managers, but in New Hampshire research is lacking. Effects of mosquito ditching, habitat loss, and invasive plants on the occurrence and abundance of willets have received some study in southern New England.

3.4 Threat Assessment Research

Threats to willet populations have not been documented in New Hampshire. Research priorities for threat assessment include population trends, effects of wetland restoration, and impacts of increased human disturbance near marsh habitat (e.g., increased road density and noise).

Research is needed to determine the effects of methylmercury on willet populations in New Hampshire. Methylmercury has become a major ecological and human health concern in the region. The Biodiversity Research Institute is investigating the effects of mercury on salt marsh birds in New England, which can provide a basis for conservation actions.

Element 4: Conservation Actions

4.1.1 Protecting remaining salt marsh habitat and surrounding upland buffer habitat, Habitat Protection

See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

4.1.2 Restoring degraded salt marshes back to Spartina dominated systems, Restoration and Management

See Salt Marshes habitat profile and Saltmarsh Sharp-tailed Sparrow profile

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5.2 Data Sources

NHBR. New Hampshire Bird Records, New Hampshire Audubon, Concord, New Hampshire.

Table 1. New Hampshire salt marshes with willet populations during the 2004 breeding season (McElroy and Babbitt, unpublished data).

SPECIES PROFILE

American Woodcock

Scolopax minor

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S4
Author: Julie Robinson and Jim Oehler, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

Woodcock (*Scolopax minor*) are an early successional species that use different habitats depending on activity, time of day, and season. Dense, shrub-dominated forests with moist soils are ideal habitats (Keppie and Whiting 1994). Moist soils ensure that earthworms, which comprise nearly 80% of woodcock diet, are near the soil surface and are available to foraging birds (Dessecker and McAuley 2001).

In spring, males need openings ("singing grounds") to perform courtship displays and attract females (Dwyer et al. 1988). Available nesting and rearing habitat determine the location of singing grounds rather than specific vegetation characteristics (Dessecker and McAuley 2001). Migrating and breeding woodcock favor areas of young aspen, birch, or alders and may also use overgrown fields, burned or recently logged areas, and wetlands (Lacaillade 1994). Nests and broods can be found in mixed-age forests, although young hardwood stands (especially aspen) are preferred (Mendall and Aldous 1943).

During summer, young hardwoods to older stands with a dense understory, particularly alder, provide daytime cover for feeding (Dessecker and McAuley 2001). In northern breeding areas, conifer stands are used rarely, except during droughts when they may be critical for survival (Straw et al. 1994). Diurnal habitats in fall and on migration are Young hardwood stands on moist soils with dense shrubs are important in the fall and during migration.

1.2 Justification

Woodcock numbers in New Hampshire tend to be stable and relatively strong compared to data from other portions of the eastern United States. Survey results for 2004 were relatively close to those reported in 2003. Southeast New Hampshire continues to show an increase in singing males, although this could be attributed to favorable survey conditions. Woodcock are most abundant in northern New Hampshire, where habitat is most suitable.

Habitat loss and degradation contribute to declining woodcock populations elsewhere in the East. Studies suggest that ground-nesting songbirds may currently be experiencing low reproductive rates (Straw et al. 1994). Decline and fragmentation of early successional forests may be limiting woodcock recruitment (Dessecker and McAuley 2001).

1.3 Protection and Regulatory Status

Woodcock hunting is regulated in New Hampshire under the waterfowl regulatory process. The American Woodcock is protected under the Migratory Treaty Act.

1.4 Population and Habitat Distribution

Breeding woodcock are relatively common throughout New Hampshire at elevations below 2,000 ft (610 m), although their numbers have declined since the 1960s in eastern New Hampshire (Lacaillade 1994). Singing ground survey data indicate that New Hampshire's highest woodcock concentrations occur in the west-central and southeast regions of the state and in northern Coos County (Lacaillade 1994). Historical records for woodcock are vague. Since the woodcock is a small game bird, it was probably not hunted until larger game began to disappear (Silver 1957). Fishermen introduced earthworms to the Umbagog Region around 1825 for bait; woodcock were believed to have appeared there shortly afterwards and were common by the late 1800s (Silver 1957). Refer to element 1.4 in the ruffed grouse or shrubland profile for information on the abundance and distribution of habitat suitable for woodcock.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

No habitat map was generated for woodcock since habitat is difficult to map using existing remotely sensed data. Refer to element 1.6 in the ruffed grouse or shrubland profiles for more information.

1.7 Sources of Information

The primary source of information was the annual woodcock report compiled by the USFWS for those states that conduct annual singing ground surveys. Information was gleaned from this document through literature reviews, research projects conducted in the region, and available databases.

1.8 Extent and Quality of Data

The quality of population data for woodcock is very good, however, confirmed breeding records are difficult to obtain due to the species' inconspicuous nesting behavior (Lacaillade 1994). Singing ground surveys have been conducted since 1968 and summarized annually. Woodcock are managed on the basis of 2 regions or populations, Eastern and Central (Kelley 2004). There is a wing-collection survey of hunters that provides age-specific data used to assess reproductive success (Kelley 2004). The ratio of immature birds per adult female in the harvest provides an index to recruitment of young into the population (Kelley 2004). Many studies on brood ecology, early successional habitat, and influence of hunting have been completed in the Northeast.

1.9 Distribution Research

Current mapping data and technology are inadequate for mapping woodcock habitat. Technologies that can assess differences in vegetation structure (e.g., radar, lidar) should be investigated and applied to generate a map of American woodcock habitat. Studies are needed to determine where early successional habitat exists and where it can be created and maintained.

Element 2: Species/Habitat Condition

2.1 Scale

Counties will be used as the conservation-planning unit for this habitat because that is the scale at which most information exists and because most technical and financial assistance (from the USDA Natural Resources Conservation Service (NRCS), University of New Hampshire Cooperative Extension, and others) is provided to private landowners by county.

2.2 Relative Health of Population

The singing ground surveys indicate that New Hampshire's highest breeding concentrations occur in the west central and southeastern regions of the state and in northern Coos County (Lacaillade 1994). The Singing-ground survey in the Eastern Region in 2004 was not significantly different than the 2003 level (Kelley 2004). In the Eastern Region, the 2004 breeding population index was 1.84 singing-males per route. This was higher than the predicted value of 1.70 (Kelley 2004). Northern New England, including New Hampshire, has experienced an increase in the breeding population indices over the past 5 years of the singing ground survey. This could be due in part to favorable weather during the surveying season.

For the wing-collection survey, the recruitment index in the Eastern Region (1.5 immatures/adult female) was slightly higher than the 2003 index, but was 12% below the long term (1963-2002) average (Kelley 2004). In 2004, New Hampshire showed a statistically insignificant increase in the recruitment index. New Hampshire's Breeding Bird Atlas reveals that woodcock are still well distributed throughout the state, and suggests that they are most common in the central and southeast regions (Lacaillade 1994).

Elsewhere in the Eastern region, population abundance indices suggest a long-term decline (Kelly 2004). Loss and degradation of wetlands have destroyed breeding, migration, and wintering habitat (Lacaillade 1994). Pesticides have affected the earthworm populations in many areas, decimating the woodcock's primary food source (Lacaillade 1994).

2.3 Population Management Status

Reliable annual population estimates, harvest estimates, and information on recruitment and distribution are essential for comprehensive woodcock management.

2.4 Relative Quality of Habitat Patches

Refer to element 2.4 in the ruffed grouse and shrubland profile for information on relative quality of habitat patches for American woodcock.

2.5 Habitat Patch Protection Status

Since no habitat map was generated, the habitat patch protection status of young forest habitats in New Hampshire is unknown. However, given the ephemeral nature of young forest habitats, tree harvesting and other vegetation manipulation techniques will need to be employed to generate suitable habitat. This can occur on both public and private land.

2.6 Habitat Management Status

See section 2.6 in the Shrubland profile.

2.7 Sources or Information

Sources of information for element 2 include journal articles, websites, GIS data, and white papers.

2.8 Extent and Quality of Information

The extent and quality of data for woodcock population information are quite good. However, information on habitat abundance and distribution is lacking.

Element 3: Species Threat Assessment

3.1.1 Development (Habitat Loss and Conversion)

Refer to "Development (Habitat Loss and Conversion)" threat in the ruffed grouse profile.

3.1.2 Altered Natural Disturbance (Natural Succession)

Refer to threats in the ruffed grouse profile.

Element 4: Conservation Actions

4.1.1 Habitat Conservation, Habitat Protection

Refer to "Habitat Conservation, Habitat Protection" strategy in the ruffed grouse profile.

4.1.2 Vegetation Management, Restoration, and Management

Refer to "Vegetation Management, Restoration and Management" strategy in the ruffed grouse profile. In addition to the strategies outlined in the ruffed grouse profile, protection and maintenance of scrub-shrub wetlands will be important for maintaining woodcock populations in New Hampshire. This can be done by maintaining natural establishment, occupancy, and abandonment of beaver flowages (see strategies in the Marsh and Shrub Wetlands profile). In some instances, regeneration of alder stands may be necessary.

Element 5: References

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SPECIES PROFILE

Non-Breeding Birds

Federal Listing: Not listed
State Listing: Not listed
Global Rank: Not ranked
State Rank: Not ranked
Authors: Pamela D. Hunt, Rebecca W. Suomala, and Carol R. Foss, New Hampshire Audubon

Element 1: Distribution and Habitat

1.1 Habitat Description

Habitat for non-breeding birds includes nearly all habitats in the state, from offshore waters to high elevation conifer forests. For this document, 11 focal areas where birds tend to concentrate have been identified (see section 1.4). In general, birds use critical habitats within focal areas in the following ways:

- Grasslands and agricultural areas are used extensively by waterfowl, seed-eating passerines, and some raptors during spring and fall migration. Depending on location and snow cover, these areas may also be used by a reduced set of species during the winter. Flooded fields are particularly important to waterfowl during spring and to a lesser extent to shorebirds during spring and fall. A few shorebirds (plovers, upland sandpiper) also congregate in dry fields in the fall.
- Early successional, scrub-shrub, and edge habitats—including forest-agricultural boundaries—often leaf-out earlier in the season and often retain both foliage and fruit later into the fall. They are important to early spring and late fall migrant land birds, as well as to frugivores in fall (Parrish 1997, 2000; Suthers et al. 2000, Rodewald and Brittingham 2004).
- Riparian forests provide important stopover habitat to migrating land birds and waterfowl (e.g., wood duck. Such areas tend to be phenologically ahead of upland forests, and thus provide a more reliable food supply—particularly for insectivorous birds—during the early phase of spring migration (mid-April through mid-May).
- Open water is important for waterfowl and waterbirds, as well as for some shorebirds, at all times of year. Some species seek open water during winter and spring migration, including by non-breeding bald eagles. Offshore salt water remains open year round, and habitat suitability here probably depends more on currents, water depth, degree of shelter, and substrate. Among passerines, swallows are particularly dependant on open water—and its associated flying insects—in spring and fall.
- Fresh-water wetlands (ponds, emergent marshes, etc.) are used by waterfowl and some waterbirds (coots, grebes, herons) primarily during spring and fall migration. Rails, bitterns, and snipe may also use marshes during migration.
- Salt marshes and tidal flats are critical feeding and roosting habitats for migrating shorebirds. Marshes and flats are also used extensively by non-breeding herons from April through October, and by post-breeding terns, gulls, and cormorants in late summer and early fall. Large numbers of salt marsh sparrows use salt marshes during migration, particularly in the fall.
- Coastal dunes habitats serve a similar function to some grasslands. These habitats are used by several species of seed-eating passerines during fall and winter, and occasionally raptors. Some shorebirds roost in dunes or on adjacent beaches at high tide.
- Rocky shorelines are used by shorebirds, gulls, cormorants, and some waterfowl throughout the year.

1.2 Justification

Birds are most vulnerable during the non-breeding season, when the stresses of migration and weather are added to the need to find food and avoid predators. Because migratory birds often spend much time away from breeding grounds, the conservation of non-breeding individuals and their habitats is critical. Conversely, if factors limit a species during winter or migration, then management on breeding grounds may not have the desired effect. Migrating birds need places to feed, rest, reorient, avoid adverse weather, and minimize other stress (predation, dehydration, etc.). Some migrant taxa, particularly shorebirds and waterfowl, regularly use the same staging areas each year, and alteration of these sites may have significant effects on populations (Moore et al. 1995, Brown et al. 2001). Even in passerines and other species with limited stopover site fidelity, broad alteration of stopover habitat may have similar effects (Sherry and Holmes 1995, Hutto 2000). Similarly, use of wintering grounds may ultimately affect breeding success (Norris et al. 2004). Non-breeding and breeding habitats are often different, forcing managers to consider multiple habitats to protect a species.

Additional threats covered in this profile include climate change, cat predation, collisions with manmade structures, and effects of pesticides and other contaminants. Their effects on migrant bird populations remain largely unknown and thus warrant future study.

1.3 Protection and Regulatory Status

There are no provisions to protect non-breeding bird habitat, except when the bird is federally listed. However, some protection is offered by many existing statutes, including the Shoreland Protection Act, conservation of agricultural lands, and wetland protection measures.

1.4 Population and Habitat Distribution

Although non-breeding habitat is distributed across the state, birds are known to concentrate in certain areas. These 11 focal areas, and the reasons for their selection, are as follows (see also table 1).

Connecticut River Valley
The open water and agricultural lands along the Connecticut River provide stopover habitat for several species of waterfowl. The north-south orientation of the valley and the presence of extensive areas of edge or early successional habitat make it an important flyway for southbound fall migrants and for northbound land birds in spring. Shorebirds comprise a minor component of the area's migrant pool, but some species may reach high densities at larger reservoirs or agricultural fields. Finally, open water provides winter habitat for bald eagles and several species of waterfowl.

Merrimack River Valley
This valley is important for the same reasons as the Connecticut River, although waterfowl and shorebird diversity is somewhat lower.

Contoocook River Valley
Because of its north-south orientation, the Contoocook may be valuable to passerines in much the same way as are the Connecticut and Merrimack valley. Yet the relative narrowness of this valley and lack of extensive farmland preclude large concentrations of migratory waterfowl, and the absence of open water precludes wintering eagles and waterfowl.

Bowman Notch
This low saddle that follows part of the Israel River valley marks one of the few east-west routes through the mountainous areas of northern New Hampshire. Some data suggest that birds moving north up the Connecticut use this gap to reach breeding areas in the Androscoggin River watershed.

Lake Umbagog/Pontook Reservoir
The extensive marshes and open water in this area attract some of the largest concentrations of loons and diving ducks in the state, as well as lower numbers of dabbling ducks. Large concentrations of shorebirds have been reported in this area. Many species of land birds use shoreline habitats, primarily in spring, and swallows often concentrate over open water. Bald eagles are attracted to open water in the winter and during fall migration.

Lakes Region
This region is similarly important, although there is less evidence of its importance to migrating land birds. Larger areas of open water make it attractive to wintering waterfowl, and many species of diving ducks reach their highest winter densities here.

Powwow River
This small area, consisting primarily of Powwow Pond, regularly hosts the state's largest spring and fall concentrations of ring-necked ducks, ruddy ducks, pied-billed grebes, and American coots.

Great Bay
Great Bay is valuable to many species throughout the non-breeding period. It supports most of New Hampshire's wintering American black ducks, Canada geese, and greater scaup. Many other waterfowl species use the Bay during spring and fall. Some species rely on nearby agricultural lands or grasslands at Pease Air Force Base for foraging. Herons, gulls, cormorants, some shorebirds, and perhaps rails use the extensive wetlands that border the bay. The extensive shoreline is important to wintering bald eagles.

Coast
Salt marshes, mudflats, dunes, and coastal thickets support significant numbers of non-breeding birds. Salt marshes and mudflats provide the most important stopover habitat in the state for shorebirds. Herons, gulls, cormorants, and terns forage in coastal wetlands from spring to early winter, and salt marsh sparrows rely on salt marshes in the fall. Sparrows and other seed-eating passerines also congregate in coastal dunes and similar open habitats.

Many species of migrant land birds congregate along coastlines, and in this heavily developed area of New Hampshire, suitable stopover habitat is limited. Habitats with fruit-bearing shrubs may be particularly important in fall, whereas forests and early successional habitats are important in spring. Large, forested wetlands are roost sites for blackbirds and other flocking species. Several species of waterfowl and waterbirds—many of which do not breed in New Hampshire—use nearshore waters, include sea ducks, gulls, terns, loons, grebes, and cormorants.

Isles of Shoals
In some ways, the Isles of Shoals are similar to the mainland coast. They are used by various migrant land birds, non-breeding or post-breeding waterbirds (cormorants, gulls, terns), and some species of shorebirds and waterfowl. A few species are far more common there than on the mainland, including common eider, purple sandpiper, and ruddy turnstone.

Offshore Waters
Offshore waters support several species not covered by any other part of this Strategy. These deeper waters between the mainland and Isles of Shoals, or beyond the islands, are used by several species of alcids and pelagic seabirds (shearwaters, storm-petrels, phalaropes, northern gannet, jaegers) that are rarely seen from land. There are also smaller numbers of gulls, loons, grebes, and sea ducks. This habitat has been included in this profile because state bird conservation needs to consider offshore species.

1.5 Town Distribution Map

Not completed for these species.

1.6 Habitat Map

The non-breeding focal areas mapped for this profile are based on focal areas originally identified for New Hampshire in the late 1990s for Partners in Flight and the Atlantic Coast Joint Venture. These areas were chosen based on bird sighting data and personal experience. The original focal areas were delimited independently for waterfowl, shorebirds, waterbirds, and land birds, and the current areas have been modified to incorporate overlap between the 4 sets where appropriate. All areas of the state support birds during migration or winter, and only areas of high concentrations or significance are addressed in this profile. Explanations of how each focal area was mapped are included in table 1.

1.7 Sources of Information

Focal areas were based on those created in the late 1990s as discussed above. Data on habitat use by non-breeding birds in New Hampshire were compiled from New Hampshire Bird Records and the authors' personal experiences. Many of these data were originally summarized under the auspices of the New Hampshire Important Bird Area program. General information on the importance of certain habitat types was obtained from the scientific literature. Many proposed research or monitoring actions are based on projects previously identified through regional bird conservation planning.

1.8 Extent and Quality of Data

Extensive data are available for some parts of the identified focal areas, but very few areas have data for the entire geographic scope, the full complement of species, or for all times of year. In many cases, the mapped focal area reflects an extrapolation of available data on species behavior to the broader landscape.

1.9 Distribution Research

Detailed research on non-breeding bird habitat is extremely limited in New Hampshire. The research projects below have been identified by in-state interests or through broader regional conservation planning (BCR 14, BCR 30).

- Conservation of habitat for wintering bald eagles will be aided by mapping (or otherwise modeling) the distribution of open water along river corridors. Habitat conservation projects could then focus on areas that are most likely to support wintering eagles. Such a project would also potentially benefit wintering waterfowl.
- In the Mid-Atlantic States, there is increasing interest in the use of RADAR to identify important stopover habitat for migrating passerines. Little is known about the factors that govern the distribution and abundance of non-breeding sea ducks and other marine species in the Northeast. Such data will be extremely valuable in the event of offshore oil spills or wind farm developments.
- There has been no consistent effort to quantify the seasonal and spatial distribution of New Hampshire's shorebirds. New Hampshire could adopt proven techniques for measuring shorebird concentrations (e.g., PRISM).
- Non-breeding distributions of many species are largely unknown, including rails, bitterns, nightjars, and owls that tend to be highly secretive or nocturnal. New Hampshire should participate in regional migration monitoring projects. Current efforts include northern saw-whet owl banding (e.g., Clayton 2004) and common nighthawk migration monitoring (Robinson and Robinson 2001).

Element 2: Species/Habitat Condition

2.1 Scale

Non-breeding bird habitat will be treated in this Strategy at the level of habitat types within focal areas.

2.2 Relative Health of Populations

Given the many habitats and species treated in this profile, and the complexities inherent to studies of bird migration, assessing the health of non-breeding birds and their habitats is beyond the scope of this profile.

2.3 Population Management Status

Only game birds—particularly waterfowl—are specifically managed during the non-breeding season in New Hampshire. Refer to state waterfowl regulations and data for more information on this subject. Management of wintering eagle populations—largely through protection of critical roosting areas—has been implemented in the Great Bay and Merrimack River areas.

2.4 Relative Quality of Habitat Patches

Non-breeding habitat can vary in mortality risk, food resources, protection from weather, and degree of human disturbance. These factors are often correlated with habitat type or extent of anthropogenic alteration. Given the complexities involved in assessing habitat quality, and the broad scale chosen for this profile, it is impossible to discuss habitat quality at the scale of individual patches. Within a given focal area, any activity that influences non-breeding birds or their habitat should be viewed in the context of migrant needs and threats on a case-by-case basis.

2.5 Habitat Patch Protection Status

Table 1 shows the percentage of each focal area that is protected by fee-simple or conservation easement. This does not include open ocean and "great ponds" which are not subject to private or public ownership in the traditional sense.

2.6 Habitat Management Status

It is not feasible to address management status at the level of either focal areas or habitat patches within them. See section 2.4 above. See also form 3 for an overview of which threats are most important in each focal area.

2.7 Sources of Information

General information on the importance of certain habitat types was obtained from the scientific literature. Many proposed research or monitoring actions are based on projects previously identified through regional bird conservation planning.

2.8 Extent and Quality of Data

Given the broad scale of the areas treated in this profile, the quality of data supporting any particular assessment of varies. For this reason, most discussion of habitat condition is highly generalized.

2.9 Condition Ranking

2.10 Condition Assessment Research

Several projects to determine the quality of non-breeding habitat have been proposed at the regional level, and the following are applicable to New Hampshire.

- **Research the effects of impoundment management on shorebirds, waterfowl, and waterbirds:** Depending on when these drawdowns occur, they can be beneficial to shorebirds or detrimental to species that require deeper or more extensive water bodies. Research could provide information about how birds use impoundments and how management could improve stopover habitat for multiple species.
- **Shorebird stopover monitoring:** Research is needed on how resource levels vary among shorebird stopover sites during the migration season. This may allow biologists and land planners to identify, protect, or restore critical areas.
- **Offshore food resource levels:** Non-breeding seabird distribution in the Gulf of Maine (and other marine areas) is greatly influenced by the abundance of plankton and baitfish (Callaghan 2003). Participation in a regional research effort may inform conservation of priority breeding species such as terns.
- **Effects of invasive plants on non-breeding songbirds:** Non-native fruiting shrubs may provide less valuable food than do native species. Habitats that appear to contain abundant food may in fact be sub-optimal habitat for migratory birds. Research on energy content and use of these species by songbirds might support programs that encourage native fruit-bearing plants in landscaping and increase support for removal of invasive plants.
- **Passerine stopover habitat:** Not all stopover habitat are equally valuable to migratory birds (Duncan et al. 2002), largely because of variability in food resources, shelter, or predation risk. Measurable indicators of habitat value for birds include mass gain, residency time, and physiological condition.

Element 3: Species and Habitat Threat Assessment

3.1.1 Unsustainable Harvest (Forestry Operations and Management), Development (Habitat Loss and Conversion), Unregulated Take, Non-Point Source Pollution (Chemical Contaminants), Agriculture

A) Exposure Pathway
Because bird migration occurs on a hemispheric scale, the birds we protect during the breeding season may face their greatest threats well beyond New Hampshire, the United States, or even the Northern Hemisphere. Three broad classes of threats that occur outside New Hampshire are identified below.

1. Deforestation and habitat conversion in Latin America and the Caribbean have long been suspected in declines of many North American land birds that migrate to the tropics. Current declines of many species that winter on the eastern slope of the Andes (Canada warbler, cerulean warbler, olive-sided flycatcher, etc.) may be partially the result of deforestation in this region (Robbins et al. 1992). As in the United States, habitat conversion, fire suppression, intensive agriculture,

pine monocultures, and development can have deleterious effects on bird populations elsewhere on their migratory route.

2. Over-harvesting. Species that occur in high concentrations, including shorebirds, terns, waterfowl, and flocking passerines (e.g., bobolink) are particularly susceptible to human consumption in parts of the developing world. Birds are particularly vulnerable at key staging or wintering areas. The extinction of formerly abundant species like the passenger pigeon and Eskimo curlew is testament to the effects of unregulated hunting on populations of migratory birds.
3. Poisoning. In many areas south of the United States, chemicals such as DDT are still in use for agriculture or mosquito control. There is increasing evidence that many chemicals used in Latin America can cause high levels of direct mortality (e.g., Swainson's hawk, Goldstein et al. 1996), and they may cause population decline in species that winter in south-temperate agricultural areas. Although the threat is probably greater in the developing world, agricultural activities in the southern United States—particularly blackbird control—may harm populations of birds that winter in these habitats, including rusty blackbird, swallows, and several sparrow species.

B) Evidence
There is an extensive literature on non-breeding season limitations on migratory birds, and only a few references have been included in this profile to illustrate specific points.

3.1.2 Development (Habitat Loss and Conversion)

A) Exposure Pathway
During migration, birds require habitat where they can rest and feed after strenuous periods of sustained flight. When such habitat is limited, as in heavily urbanized areas, birds are forced into smaller patches, which may be further compromised by predators, light pollution, contaminants, and human disturbance. Many migratory species are affected by loss or degradation of river valleys, coastal areas, and even ridgelines (used by migrating hawks). In addition, some migrants are known to be area sensitive during migration and may suffer reduced fitness in heavily fragmented landscapes.

B) Evidence
There is an extensive literature documenting the importance of stopover habitat to migrating birds. Much of the recent research on this topic has been summarized in Moore 2000 and the references therein.

3.1.3 Predation and Herbivory (Subsidized or Introduced Predators)

A) Exposure Pathway
As landscapes become more urbanized, birds are threatened by domestic or feral cats. Birds in a weakened condition, or otherwise disoriented by windows or lights, may be especially vulnerable.

B) Evidence
Evidence suggests that cats kill several hundred million birds each year in the United States (American Bird Conservancy). The indirect effects of cat predation on migratory birds are poorly understood, and there are few data on how predation varies seasonally. Nonetheless, when combined with other sources of mortality caused by human activity (window and tower kills), cat predation could be a significant drain on breeding populations.

3.1.4 Agriculture (Land/Crop Conversion)

Not all agricultural areas are equally suitable for migrating birds. Broad types are arranged from most to least suitable as follows: grains, row crops, hayfields, fallow fields, and sod farms. Economic pressures often result in farmland conversion from more suitable to less suitable types, and this conversion may have immediate detrimental effects on local congregations of birds (especially waterfowl) that rely on waste grain during migration.

3.1.5 Recreation (Boats and Jet Skis)

Extensive use of boats and jet skis on water bodies used by migrating birds may cause repeated flushing or may otherwise reduce the time birds spend resting or foraging. Increased energy use and decreased food intake may affect seasonal migration, and thus have indirect effects on individual fitness and population health.

3.1.6 Recreation

The effects of human foot traffic on migrating birds are similar to those discussed above. The best examples are disturbance of bald eagles at winter roost sites and shorebirds at beach roosts. For example, repeated disturbance of roosting shorebirds has been shown to reduce the birds' ability to put on fat and concomitantly reduce their chances of surviving migration (Pfister et al. 1998).

3.1.7 Energy and Communication Infrastructure

There is extensive evidence that birds experience large mortality events at television and radio towers (Shire et al. 2000, www.towerkill.com), and all such structures cause regular low levels of mortality. Nocturnal birds tend to be attracted to lights on such towers, and sometimes they become disoriented and crash into the towers or their associated guy wires. The proliferation of towers for cellular communication will increase this risk, and towers located near migration routes may be particularly dangerous. As of 1999, there were roughly 60 towers in New Hampshire over 200 feet tall, the height at which towers start posing a greater threat (Braile 1999). Although large mortality events have not been recorded in New Hampshire (but see Sawyer 1961), the issue has received little study, and its overall magnitude remains unknown.

Although there are no wind power facilities in New Hampshire, evidence from elsewhere suggests that they can sometimes cause high levels of avian mortality (Birdlife International 2003, Schwartz 2004). Mortality appears important in raptors in the West, whereas limited data from the East suggest that migrating bats may be more at risk than birds (Kerns and Kerlinger 2004). Offshore wind power may pose a threat to waterfowl or waterbirds depending on location, and may include direct mortality and behavioral modification (Yulp et al. 1999).

3.1.8 Climate Change, Altered Natural Disturbance

Although the habitat-level effects of climate change (sea level rise being the exception for shorebirds and other coastal taxa, Galbraith et al. 2002) are not likely to influence migrating birds (they are adapted to using multiple habitats), disruption of seasonal patterns may be detrimental. Many species of migratory birds have shifted their arrival dates as much as 3 weeks earlier over the last several decades (Price and Root 2002). Such shifts in migration phenology can decouple bird migration peaks from peaks in food supply (e.g., McCarthy 2004), though effects on migrants' survival and ability to put on fat are unknown. Similarly, shifts in weather patterns may influence migratory behavior.

3.1.9 Development (Light Pollution)

Heavily lit urban areas can attract nocturnal migrants (many songbirds, cuckoos, owls, rails) that become disoriented and may die in collisions with structures. Disoriented birds, in turn, may be more susceptible to predation, or may find themselves in inhospitable environments with limited foraging opportunities. Some researchers estimate that upwards of 100 million birds are killed annually in this manner in North America (FLAP).

3.2 Sources of Information

Information on habitat-based threats was obtained largely from the scientific literature and summaries thereof. For broad-based but still poorly understood threats such as collisions and cat predation, most information came from reports written by bird conservation organizations available on the web.

3.3 Extent and Quality of Data

Effects of habitat loss and alteration on the winter grounds are well documented in scientific literature. Stopover habitat issues are also becoming better understood, although there are fewer direct connections between stopover events and population dynamics. Data on mortality (cats and towers), effects of climate change, and light pollution are rarely collected in a consistent manner across numerous locations, and extrapolations of these data to the broader scale are necessarily rough.

3.4 Threat Assessment Research

For some of the "low" threats discussed above (particularly climate change, cats, towers, wind power, and light pollution), one of the main reasons for their low rank is a lack of information on the timing and severity of the threat. New Hampshire could participate in ongoing monitoring occurring elsewhere in the region.

There are also very few data with which to evaluate the effects of habitat loss or fragmentation on birds that migrate through New Hampshire. RADAR, in conjunction with data on landscape characteristics, can determine whether fragmented or degraded areas are used to the same degree as more intact habitats.

Other research would focus on the effects of human disturbance on non-breeding birds. Some such studies are planned or underway (bald eagles) or are already completed (shorebirds), but they lack for small land birds and aquatic birds.

It is critical to identify and research potential threats to priority species on their winter grounds (in Latin America, the Caribbean, and the southern United States). Research may include the effects of habitat conversion, pesticides, and agricultural practices.

Element 4: Conservation Actions

4.1.1 Outreach on cross-border and diffuse effects (coffee, pesticides, PIF, etc.), Education and Outreach

Threat addressed: Out-of-state Activities

In the early 1990s, Partners in Flight (PIF) and its partner organizations raised awareness of the effects of extra-national activities on North America's breeding birds. In the decade since, initiatives such as the promotion of shade-grown coffee have been relatively successful in 'bringing home" the connections between breeding and wintering areas, but more work needs to be done. Important issues that may be particularly suitable for grassroots activism include pesticide use in South America, climate change, and mortality associated with towers and lighted structures. At stopover sites, initiatives such as the Important Bird Area program, Western Hemisphere Shorebird Reserve Network, and others can galvanize local support for land conservation, which in turn can increase local awareness of other issues affecting migrant birds.

4.1.2 Land Conservation in Priority Corridors, Habitat Protection

Threats addressed: Loss of stopover habitat

Available research indicates that migrants need multiple stopover sites and a wide variety of habitats (Petit 2000, R. Suomala unpubl. data). For many land birds, important habitat features include fruit-bearing shrubs and large enough habitat patches to attract area-sensitive species. Edge habitats should be maintained or enhanced to manage or restore habitat for migratory songbirds (Suthers et al. 2000). Habitat protection (or management/restoration) at this scale will require more baseline data on the primary species or species groups that use the landscape.

4.1. 3 Local Stopover Habitat Education, Education, and Outreach (with potential to include Regulation and Policy)

Threats addressed: Loss of stopover habitat

Local communities can encourage or implement land use policies that benefit migratory birds (Mabey and Watts 2000). Such policies could include landscaping with fruit-bearing shrubs or shelter-providing conifers (C. Foss, personal observation), bird-friendly zoning, and tax incentives to maintain critical habitats. Attempt to influence local land use should be combined with outreach pertaining to an area's value to migratory birds (along lines of 4.1.1) and, where appropriate, discussion of the potential "nature tourism" value of maintaining migrant habitats.

4.1.4 Cats Indoors Campaign, Education and Outreach

Threats addressed: Cat predation

The American Bird Conservancy has initiated an outreach campaign directed toward minimizing the hazards posed by cats to native wildlife. To be broadly successful, such an effort should be supported by multiple conservation organizations and pet-advocacy groups (Humane Societies, SPCA). There may be considerable resistance to control of feral cats by some parties, which only a concerted outreach campaign is likely to overcome. In addition, state and local governments should consider the feasibility of legislation prohibiting cats outdoor without a leash, much as with current leash laws for dogs.

4.1.5 Management agreements with farmers, Restoration and Management OR Education and Outreach

Threats addressed: Change in crops

The Farm Bill, Current Use, and the Conservation Reserve Program encourage existing agricultural practices (or discourage conversion of agricultural lands). These tools should be applied in situations where there is greatest risk of farmland conversion to less suitable land use as described in section 3.1.4. In situations where income is not the primary purpose of agricultural land (e.g., "gentleman farmers"), there is an opportunity to encourage land use compatible with the needs of migratory birds.

4.1.6 Outreach on (or regulation of) impacts of human disturbance (especially on eagles and shorebirds), Education and Outreach OR Regulation and Policy

Threats addressed: Human disturbance (both aquatic and terrestrial)

Changing human behavior will benefit non-breeding birds during important resting or feeding periods. These include:

- Limiting access to critical roosting (shorebirds, eagles) and feeding (shorebirds) areas
- Providing "limited disturbance areas" at major waterfowl concentration areas (this may need to be implemented in the context of existing hunting regulations)

4.1.7 Adopt bird-friendly tower siting and design policies, Regulation and Policy

Threats addressed: Mortality at communication towers

FCC regulations require that all towers over 199 feet tall be lighted, as well as those near airports or along major highways. Provisions guiding tower placement and lighting that would reduce their threat to migrating birds need to be addressed, especially in areas where migrants are known to be relatively concentrated (e.g., focal areas). Shire et al. (2000) list several recommendations that would help minimize bird mortality at communications towers, including:

- When possible, use existing towers or structures for placement of new antennae
- Make new towers under 200 feet tall so lighting is not required
- If lighting is necessary, use the minimum amount and intensity allowed under FCC regulations
- Dismantle inactive towers as soon as possible
- Minimize lighting for on-ground facilities associated with towers
- Existing evidence suggests that use of white strobes may result in less circling behavior by nocturnal migrants and thus cause fewer mortalities than red pulsating lights. However, additional research is needed before implementing this recommendation

4.1.8 Establish Wind Power Facility Site Review Regulations, Regulation and Policy

Threats addressed: Mortality at wind farms

Data on the effects of wind power are limited (but see section 3.1.7), so first steps in addressing this threat should include consideration of siting regulations. Wind farms should not be built in areas where they will pose a high risk to birds, and proposals should thus include provision for detailed pre-construction assessment of bird use. When possible, facilities should follow any "best design practices" that may be developed as research progresses on the effects of wind farm affects on birds and bats. In the event that any wind farms are constructed, it is imperative that provisions be included for monitoring of bird and bat mortality for comparison to pre-construction use patterns.

4.1.9 Reduce light pollution, Education and Outreach OR Regulation and Policy

Threats addressed: Light pollution

Some North American cities (Toronto, Chicago) have implemented "lights out" programs during peak migration periods. Under these programs, cooperating building owners and managers agree to turn out decorative lights or draw blinds during the evening hours. The overall degree of light pollution can be markedly reduced if buildings comply (see www.lightsout.audubon.org/). In addition, there is growing interest in many municipalities to reorient street lighting so that it is more directed toward the ground and thus less disorienting to birds. All such measures have the benefit of reducing energy use.

4.1.10 Advise Inter-agency Risk Assessment Teams about Risks to Non-breeding Birds, Policy and Regulation

Threats addressed: Wind energy, climate change

NHFG will develop a strategy to initiate Interagency Wildlife Risk Assessments for several broad-based threats that affect the state's wildlife and their habitats. When these Assessments are implemented, it is critical that issues related to non-breeding birds and their habitats are included in discussions of the effects of these threats and the actions that may be needed to address them.

Element 5: References

5.1 Literature

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Element 6: List of Figures

Focal Area	% protected	includes:
Connecticut River Valley	7.57	
Merrimack River Valley	9.85	
Contoocook River Valley	27.33	
Bowman Notch	22.85	
Lake Umbagog/Pontook Reservoir	12.23	
Lakes Region	0.09	
Powwow River	15.25	
Great Bay Grasslands	32.83	Great Bay
Great Bay Wetlands	54.91	Great Bay
Saltmarsh and intertidal flats	6.93	Great Bay, Coast
Coastal shoreline and nearshore waters	1.34	Coast
10 miles inland	11.65	Coast
Combined Great Bay/Coast	11.73	
Offshore Waters	0	Isles of Shoals

Table 1. Percentage conserved land in non-breeding bird focal areas and habitats. Because of the way the Great Bay and Coastal focal areas were created in the GIS process, the areas listed below do not necessarily correspond with those listed in Section 1.4. The appropriate focal areas from Section 1.4 are listed for reference in Table 1.

SPECIES PROFILE

Eastern Meadowlark

Sturnella magna

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S3B

Author: Alina, J. Pyzikiewicz, New Hampshire Fish and Game

Element 1: Distribution and Habitat

1.1 Habitat Description

The breeding habitat of the eastern meadowlark includes fields and open areas with perches, such as trees and fence posts, for singing males to establish and defend territories and to attract mates (Steele 1994, Lanyon 1995, DeGraaf and Yamasaki 2001). The eastern meadowlark forages for insects on the ground, occasionally probes the soil for grubs, and supplements its diet with seeds in the winter (Lanyon 1995). Eastern meadowlarks build their domed nests on the ground in dense vegetation or shallow depressions (Steele 1994, Lanyon 1995). Winter habitats are similar to breeding habitats, with the addition of feedlots and marshes (Lanyon 1995).

1.2 Justification

Populations of eastern meadowlarks have been slowly declining, particularly in the Northeast, where old fields and farmland are being developed or converted to woodland (Steele 1994, Lanyon 1995, Vickery et al. 1999). Surveys in 1994 yielded 14 breeding pairs, and in 2004, only 2 were observed (United States Geological Service Patuxent Wildlife Research Center 2005). Agriculture practices such as mowing during nesting season have reduced productivity of the eastern meadowlark (Lanyon 1995, Vickery et al. 1999). Eastern meadowlarks are also susceptible to brood parasitism by brown-headed cowbirds (*Molothrus ater*) (Laynon 1995).

1.3 Protection and Regulatory Status

The eastern meadowlark is protected under the Migratory Bird Treaty Act and through various grassland bird conservation programs (North American Bird Conservation Initiative, Partners in Flight Northeast Grassland Bird Working Group).

1.4 Population and Habitat Distribution

The range of the eastern meadowlark extends from central Canada eastward through the Atlantic states and provinces down to Florida and Mexico, southward to Texas, and westward to central Arizona (Lanyon 1995).

In New Hampshire, eastern meadowlarks can be found in extensive fields, grasslands, and farmlands, as well as in contemporary habitats such as airport safeways, military installations, and golf courses. Meadowlarks are not found in the extreme north and southwest parts of the state (Steele 1994, Lanyon 1995, New Hampshire Audubon unpublished data). The New Hampshire Natural Heritage Bureau Database (2005) notes 29 locations where eastern meadowlarks have been observed (breeding and nonbreeding), with a concentration of 9 locations in the seacoast region.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

See Grassland habitat profile.

1.7 Sources of Information

Birds of North America, New Hampshire Breeding Bird Atlas, New England Wildlife, breeding bird surveys and other unpublished survey reports.

1.8 Extent and Quality of Data

Eastern meadowlark habitat and population distribution is well studied, but little is known about nutrition, productivity, and wintering ecology (Vickery et al. 1999). Population data in New Hampshire are limited.

1.9 Distribution Research

- Identify and protect key grassland habitat areas
- Continue monitoring grassland habitats to better assess eastern meadowlark abundance trends
- Conduct productivity and survival studies to provide information needed for determining causes of population declines

Element 3: Species Threat Assessment

See Grasslands habitat profile.

Element 4: Conservation Actions

See Grasslands habitat profile.

Element 5: References

5.1 Literature:

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5.2 Data Sources

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SPECIES PROFILE

Eastern Towhee

Pipilo erythrophthalamus

Federal Listing: Not listed
State Listing: Not listed
Global Rank: G5
State Rank: S4B
Author: Pamela D. Hunt, Audubon Society of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

Eastern towhees use a variety of early successional and other shrub-dominated habitats, including pine barrens, old fields, power line corridors, coastal shrub-scrub, and occasionally the shrubby portions of bogs and fens. The species also occurs in forested habitats if overstory trees are scattered (woodland habitat) or the shrub layer is well developed (Greenlaw 1996). In West Virginia, towhees responded positively to defoliation caused by gypsy moth outbreaks (Bell and Whitmore 1997). In Massachusetts pine barrens, towhees occupied habitats at a variety of successional stages and did not appear to select microhabitats within the broader habitat type (Morimoto and Wasserman 1991). In New Hampshire, towhees are sometimes found in the shrubby vegetation on some mountaintops, especially if the area had been burned (Foss 1994).

Fire suppression in southeastern United States pine savannahs results in increasing density and height of hardwood species (Engstrom et al. 1984). At one such site in Florida, towhee numbers increased in the years immediately following initial fire suppression, presumably in response to the increased shrub layer. As succession continued, however, towhee numbers began to decline, and the species was no longer present at the site 15 years after the last burn (Engstrom et al. 1984). These and other data indicate that towhees are often most common in shrubby habitats with low densities of saplings (vs. shrubs), suggesting in turn that not all early successional stages are equally suitable for the species. In addition, Wells (2003) determined that towhee populations inhabiting powerline rights-of-way were not sustainable. Whether this is a result of generally low habitat availability in the study area (southeastern New Hampshire) or specific habitat characteristics is a subject needing further study.

1.2 Justification

Based on Breeding Bird Survey (BBS) data, eastern towhees have been declining over most of their range. The decline has been particularly severe in the Northeast, where towhees have declined at an annual rate of 3.0% since 1966 (Hagen 1993, Sauer et al. 2004). Elsewhere in the East, the long-term decline may have become less severe since the late 1970s, and in some regions formerly declining towhee populations appear stable or perhaps increasing (Sauer et al. 2004). In New Hampshire, the annual decline of 9.2% is the second largest significant decline of any species based on Breeding Bird Survey (BBS) data (behind the brown thrasher). Breeding Bird Survey data from New Hampshire show the most dramatic decrease in the late 1970s, when the average number per route dropped from 15-20 to 5 over a period of only 5 years (figure 1). Since this large drop, populations have continued to decline, although at a slower rate. Because of these significant population declines across most the species' range, the eastern towhee has been listed as a "stewardship species" in the Eastern Avifaunal Biome by Partners in Flight (Rich et al. 2004). Although towhees are not rare enough to be listed in any jurisdiction, their continued decline and absence from areas of seemingly suitable habitat remains cause for concern (Hagen 1993).

1.3 Protection and Regulatory Status

This species is protected under the Migratory Bird Treaty Act, which prevents the killing of most non-game birds and collection of their nests or eggs.

1.4 Population and Habitat Distribution

In New Hampshire, eastern towhees are largely restricted to areas south of the White Mountains. Data from the BBS and the Breeding Bird Atlas (Foss 1994) show occasional records north of the mountains in the Connecticut and Androscoggin River valleys, but the species should not be expected there and BBS data suggest that towhees were extirpated from this part of the range during the decline in the 1970s. Towhees are fairly evenly dispersed over most of their range, with generally lower densities along the northern periphery (including New Hampshire, Sauer et al. 2004). Given the magnitude of decline, it is reasonable to assume that New England formerly supported a much more significant portion of the species' global population than it does today.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

Not applicable

1.7 Sources of Information

Information in this profile was gathered from the relevant scientific literature. Raw BBS data for New Hampshire were obtained via the BBS website.

1.8 Extent and Quality of Data

Because towhees are easily identifiable and widely distributed, data on population distribution and trends are generally assumed to accurately reflect the species' status in the state and across the range as a whole.

1.9 Distribution Research

Very little is known about the demography of this species (Hagen 1993). Data on nest site selection, reproductive success, and response to landscape level habitat change may allow biologists to better understand the mechanisms behind population declines and the absence of towhees from apparently suitable habitat across much of its range in New England.

Element 5: References

5.1 Literature

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Sauer, J.R., J.E. Hines, and J. Fallon. 2004. The North American Breeding Bird Survey, Results and Analysis 1966-2003. Version 2004.1, USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA.

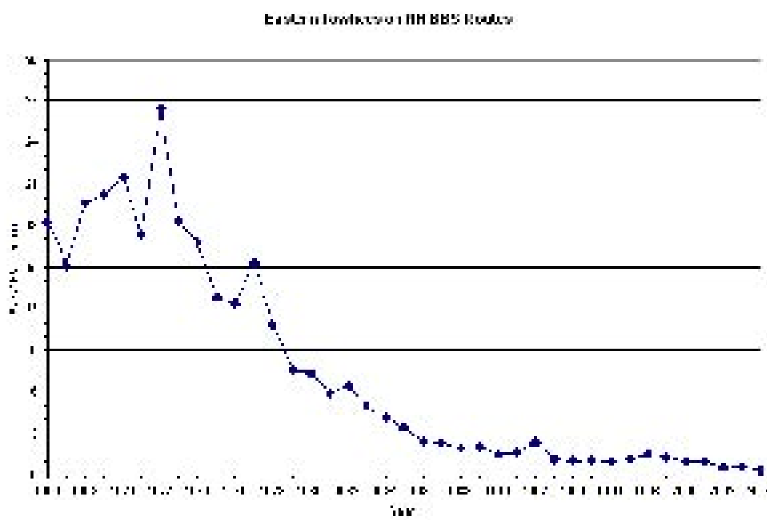
Wells, D.B. 2003. Shrubland bird diversity and productivity along powerline rights-of-way in southeastern New Hampshire. Masters Thesis, University of Vermont, Burlington, Vermont, USA.

5.2 Data Sources

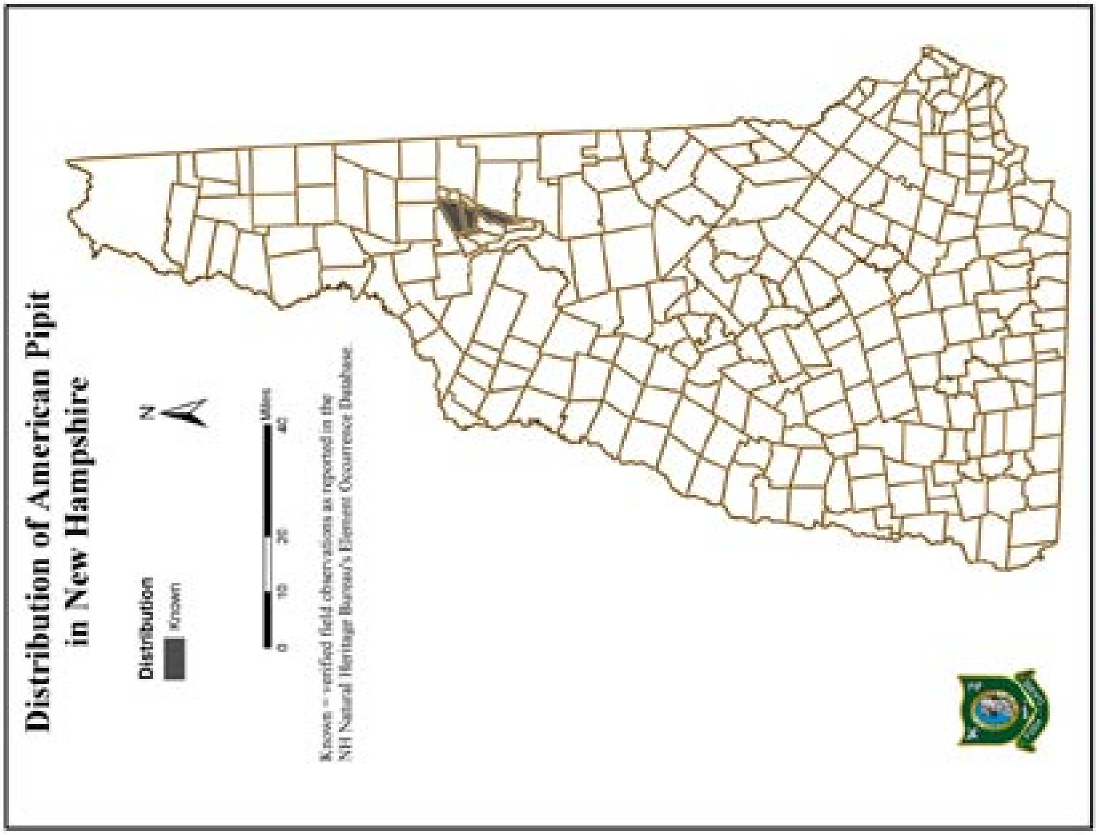
Breeding Bird Survey raw data were obtained from: http://www.pwrc.usgs.gov/bbs/retrieval/menu.cfm

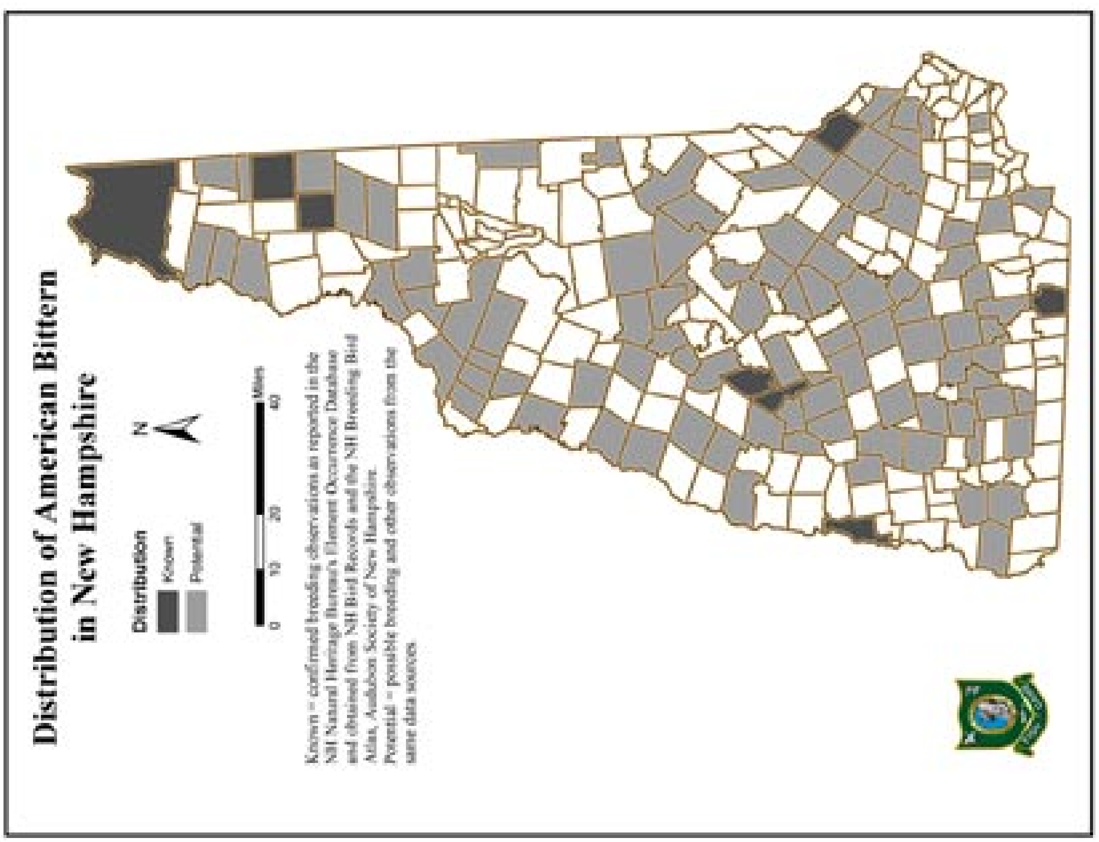
Element 6: List of Figures

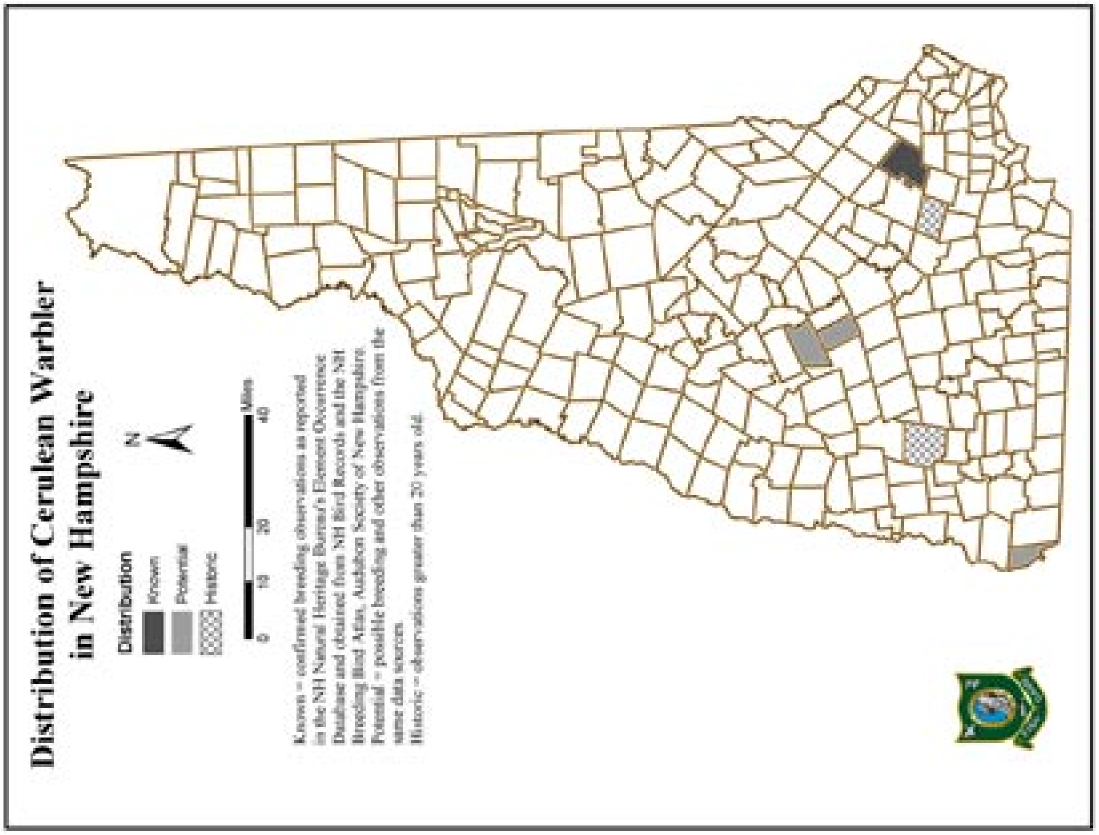
Figure 1. Average abundance of the eastern towhee on New Hampshire Breeding Bird Survey Routes, 1966-2004.

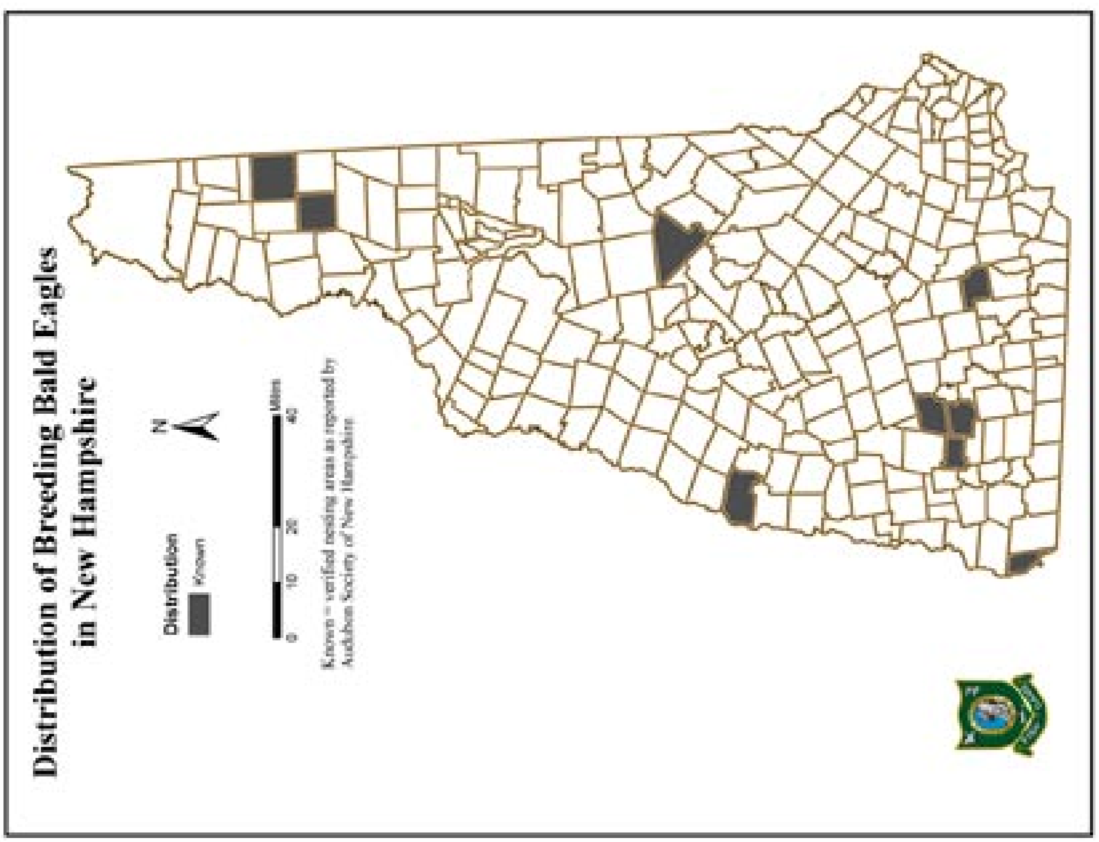


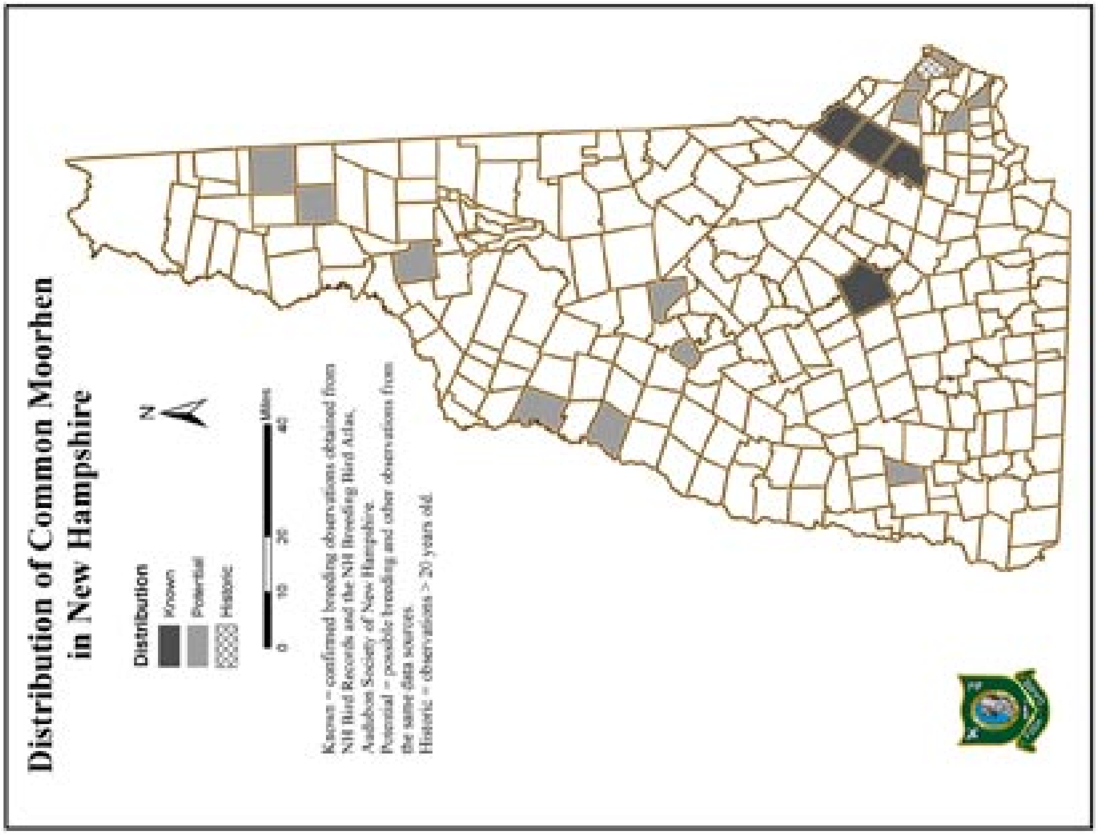
Bird Maps

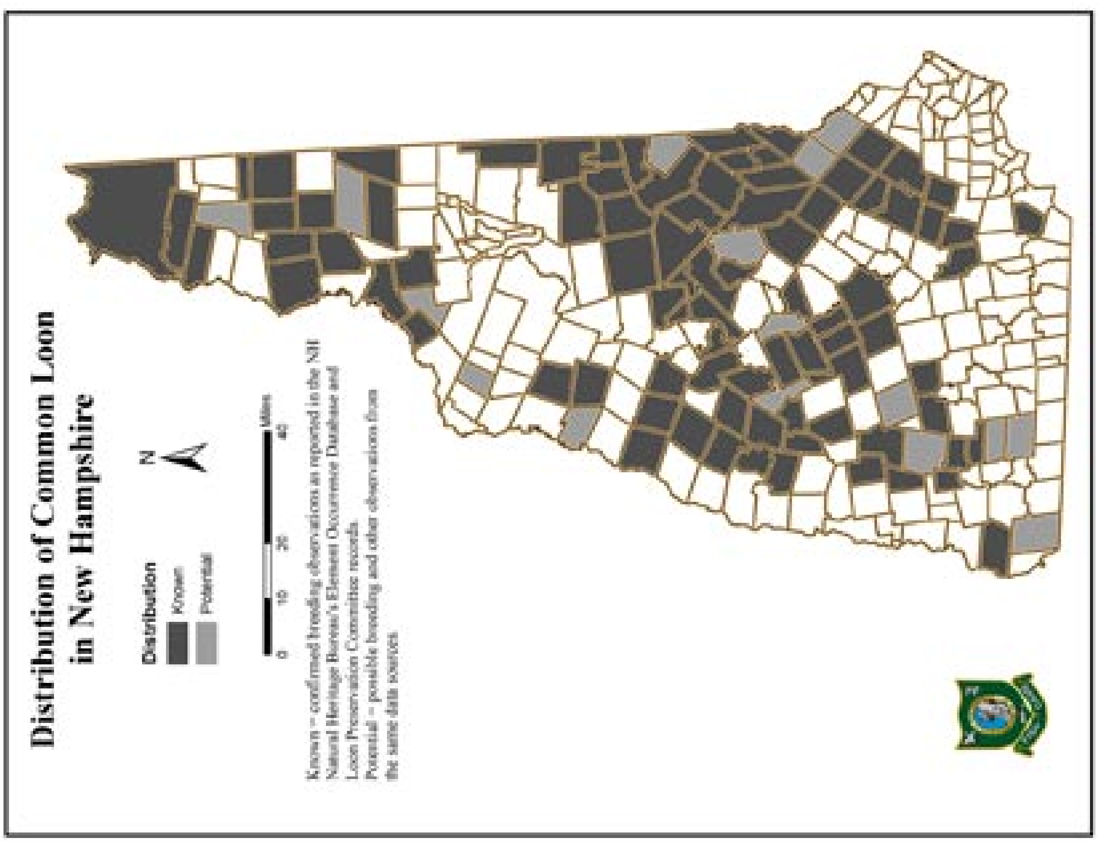

Distribution of American Pipit
in New Hampshire
Distribution
Known
N
0 10 20 40
Miles
Known = verified field observations as reported in the
NH Natural Heritage Bureau's Element Occurrence Database.


Distribution of American Bittern
in New Hampshire
Distribution
Known
Potential
N
0 10 20 40
Miles
Known = confirmed breeding observations as reported in the
NH Natural Heritage Bureau's Element Occurrence Database
and obtained from NH Bird Records and the NH Breeding Bird
Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the
same data sources.

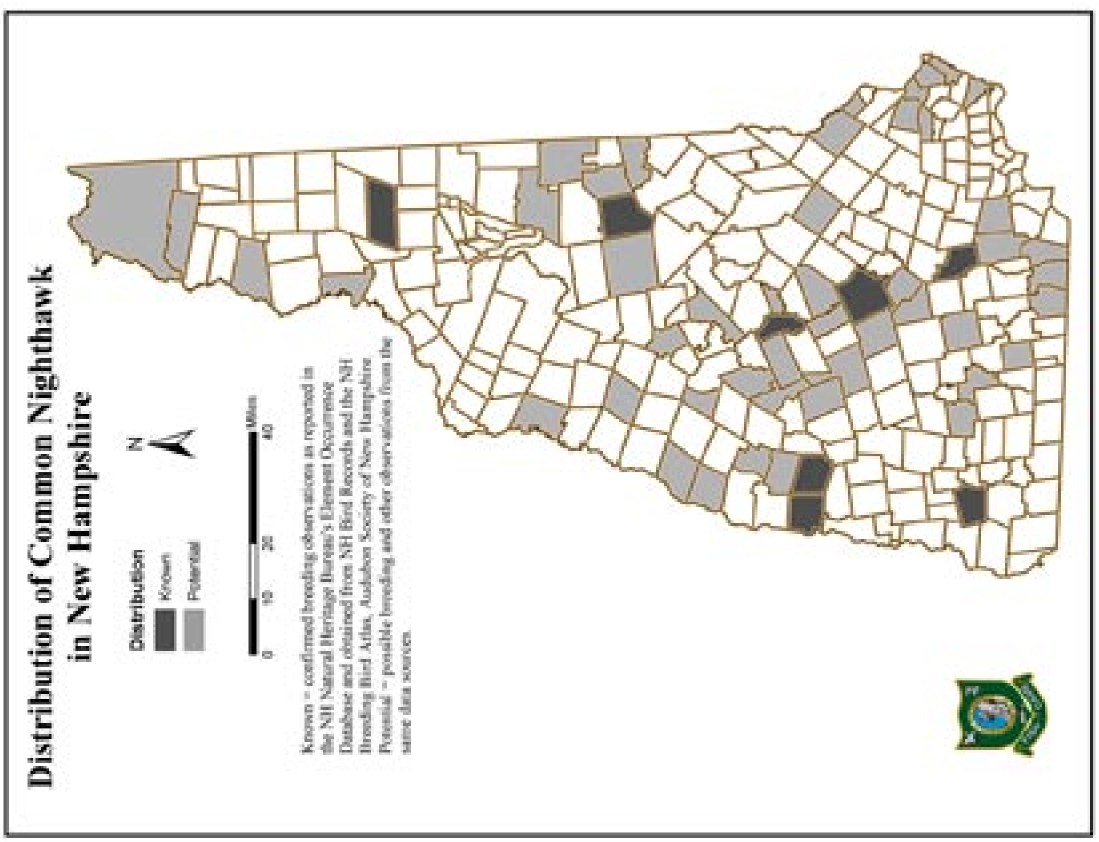

Distribution of Cerulean Warbler in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.

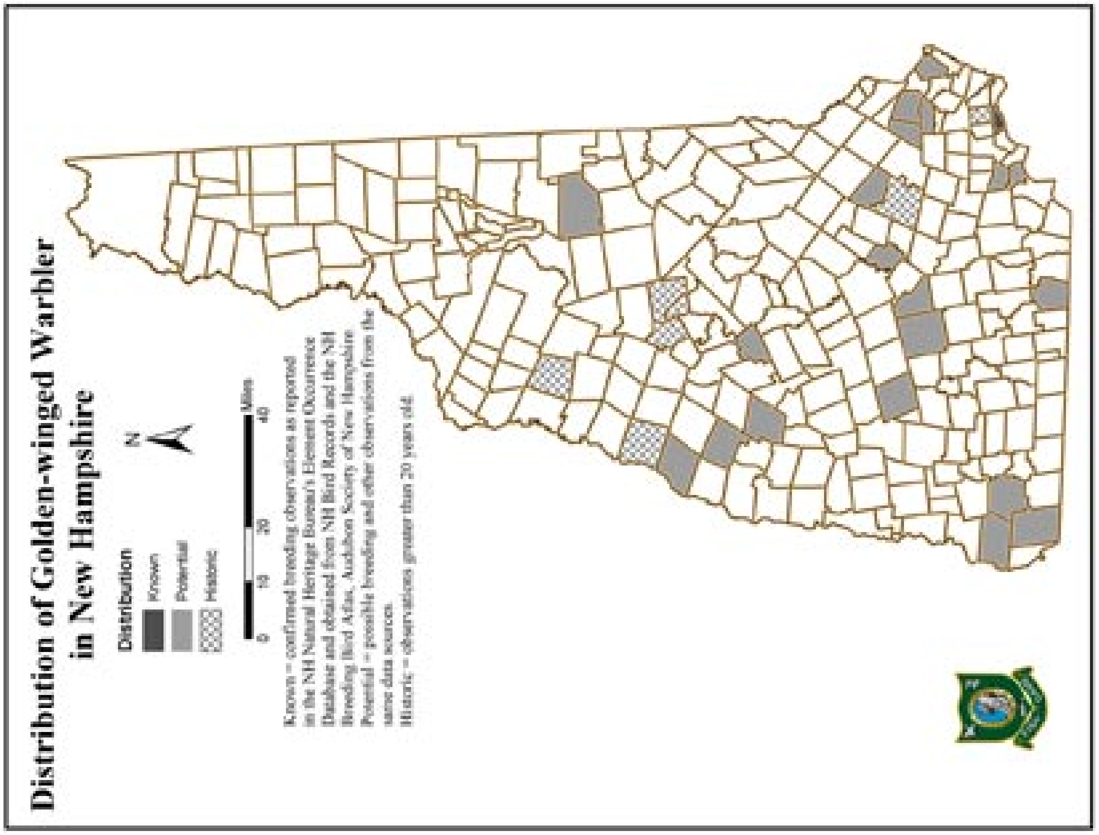

Distribution of Breeding Bald Eagles in New Hampshire
Distribution
Known
N
0 10 20 40 Miles
Known = verified nesting areas as reported by Audubon Society of New Hampshire

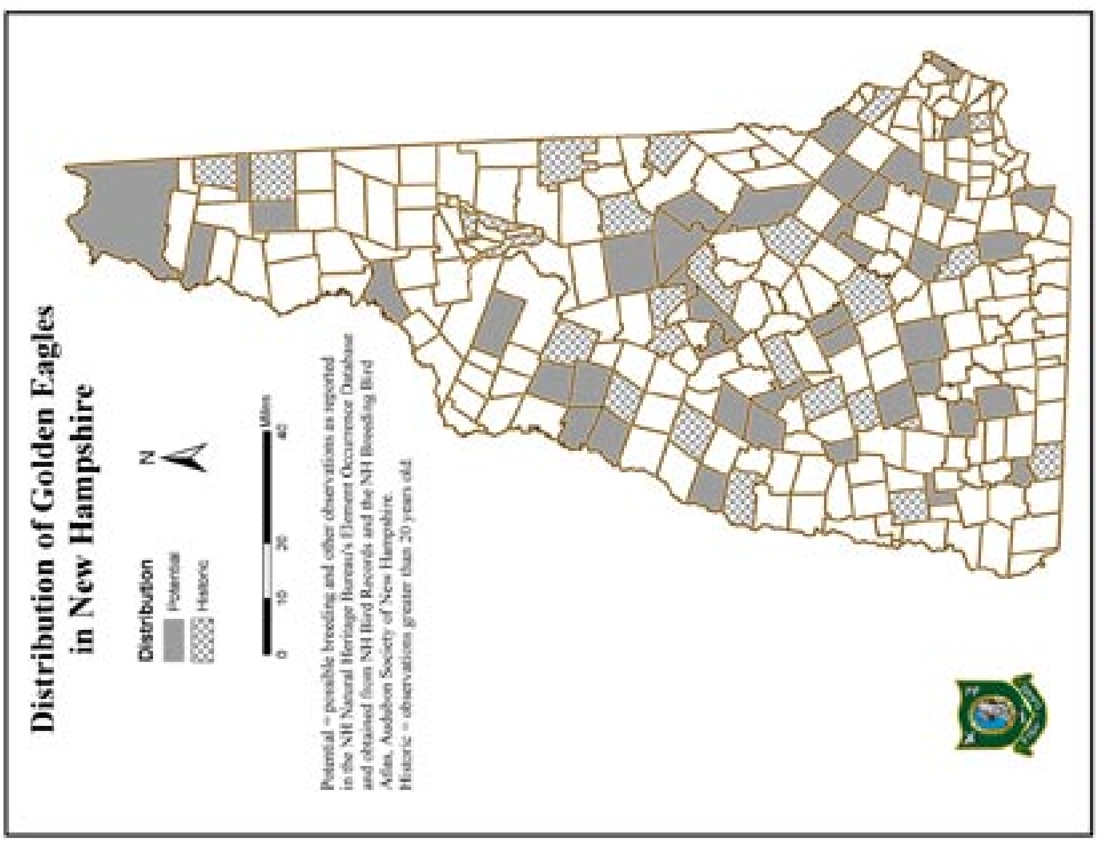

Distribution of Common Moorhen in New Hampshire
Distribution
Known
Potential
Historic
0 10 20 40 Miles
N
Known = confirmed breeding observations obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations > 20 years old.

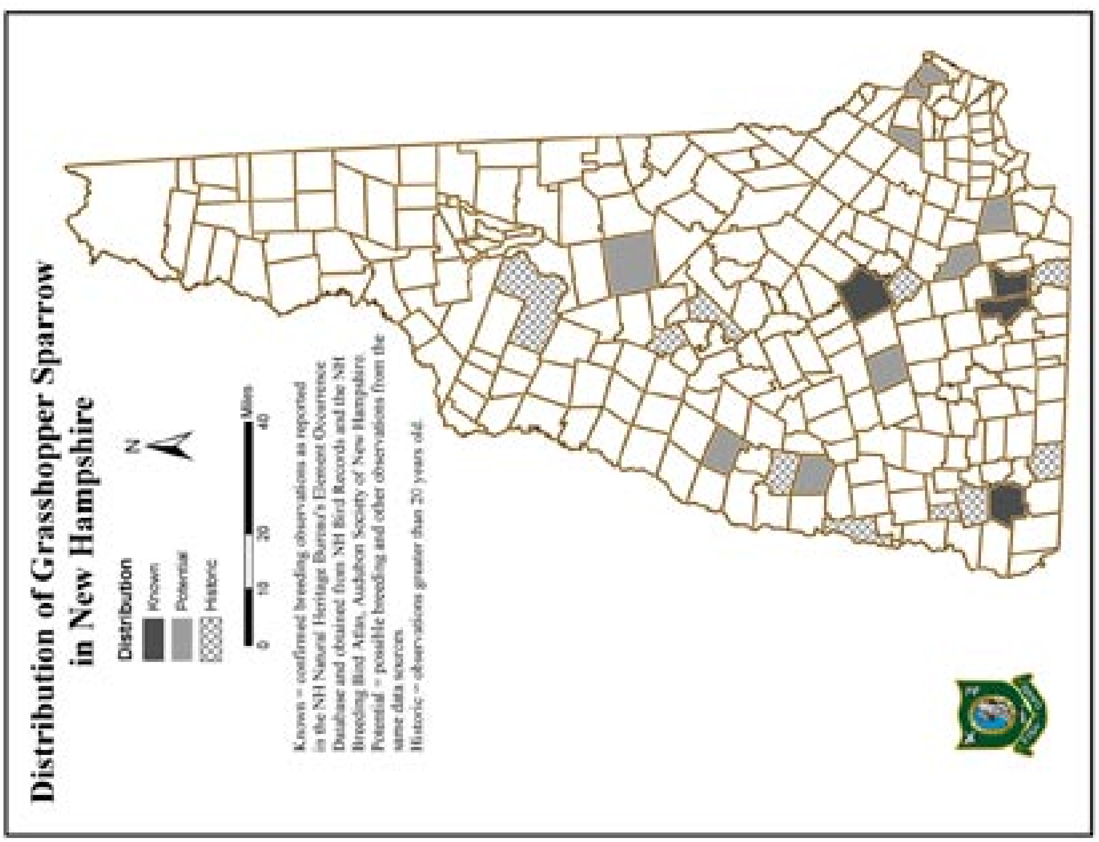

Distribution of Common Loon in New Hampshire
Distribution
Known
Potential
0 10 20 40 Miles
N
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and Loon Preservation Committee records.
Potential = possible breeding and other observations from the same data sources.

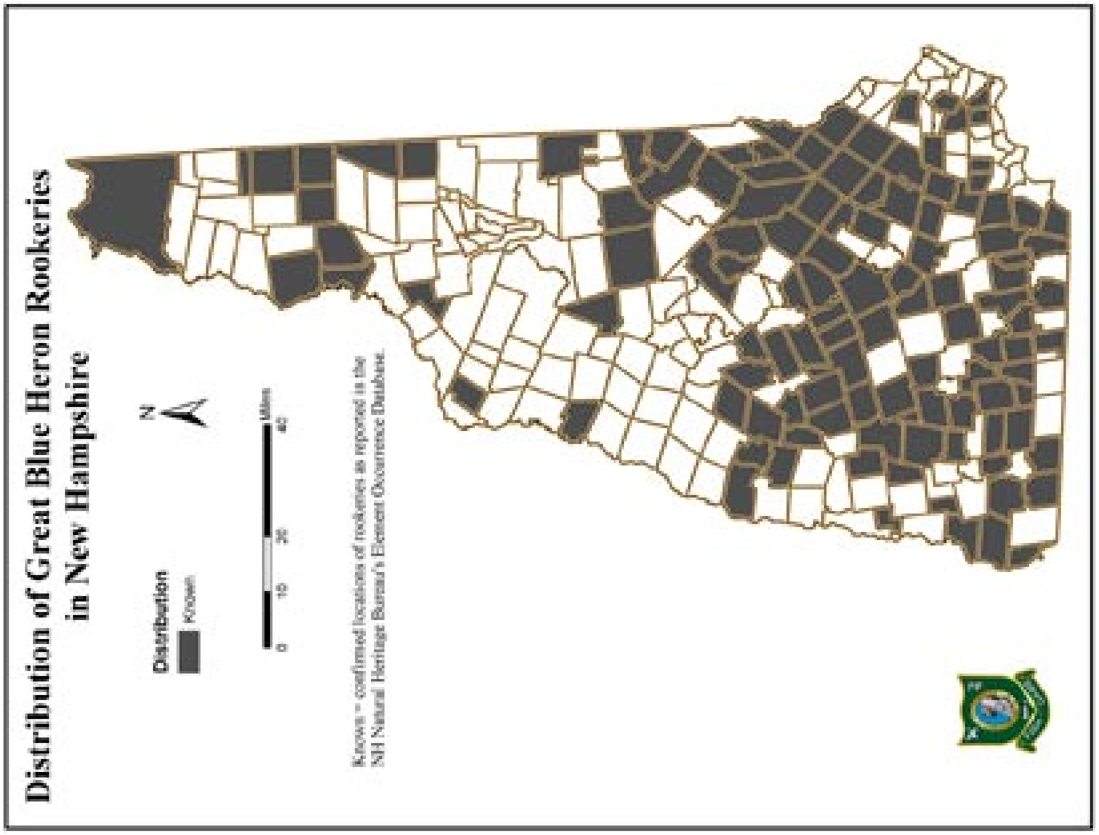

Distribution of Eastern Meadowlark in New Hampshire
Distribution
Potential
N
0 10 20 40 Miles
Potential – possible breeding and other observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.

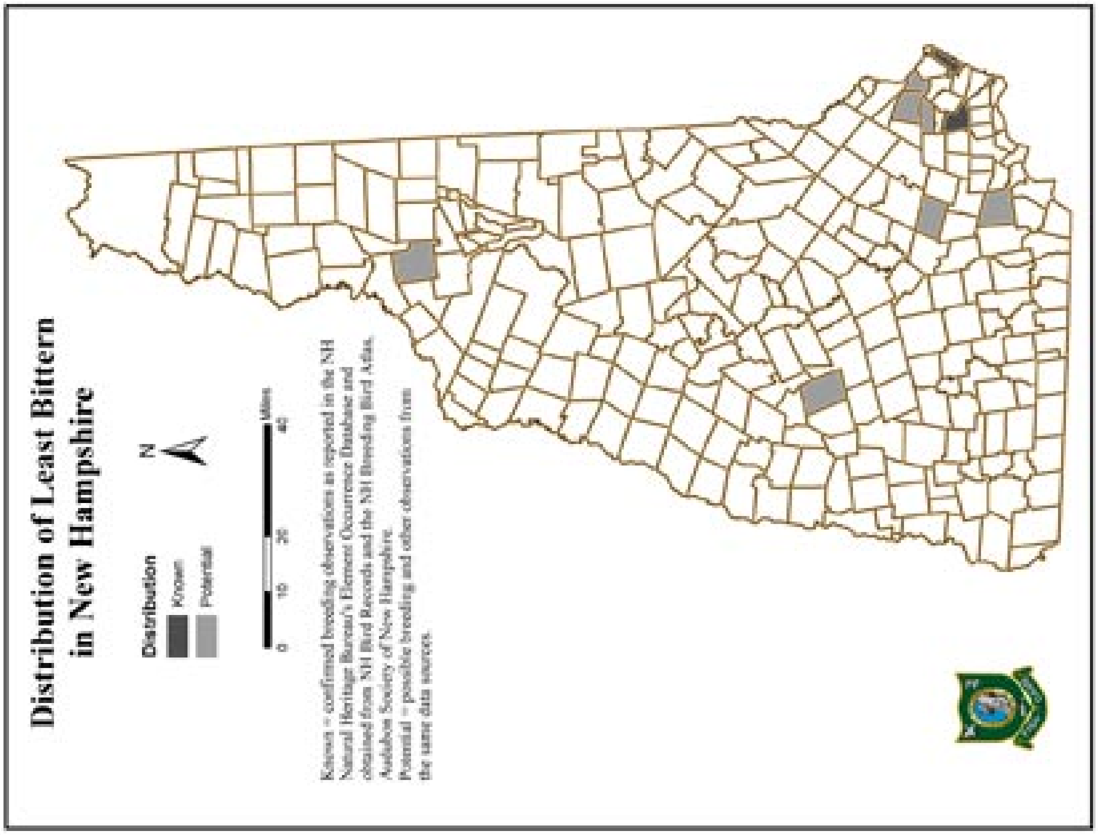

Distribution of Common Nighthawk in New Hampshire
Distribution
Known
Potential
N
0 10 20 40 Miles
Known – confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential – possible breeding and other observations from the same data sources.

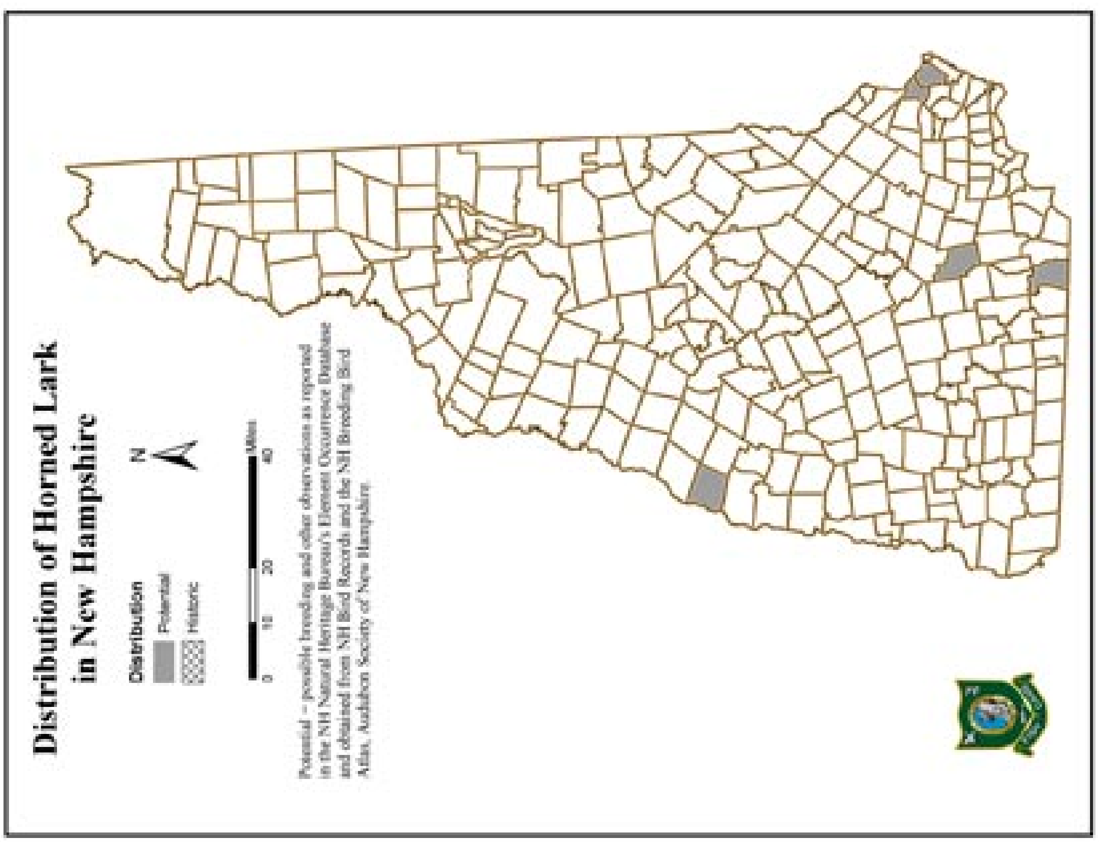

Distribution of Golden-winged Warbler
in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.

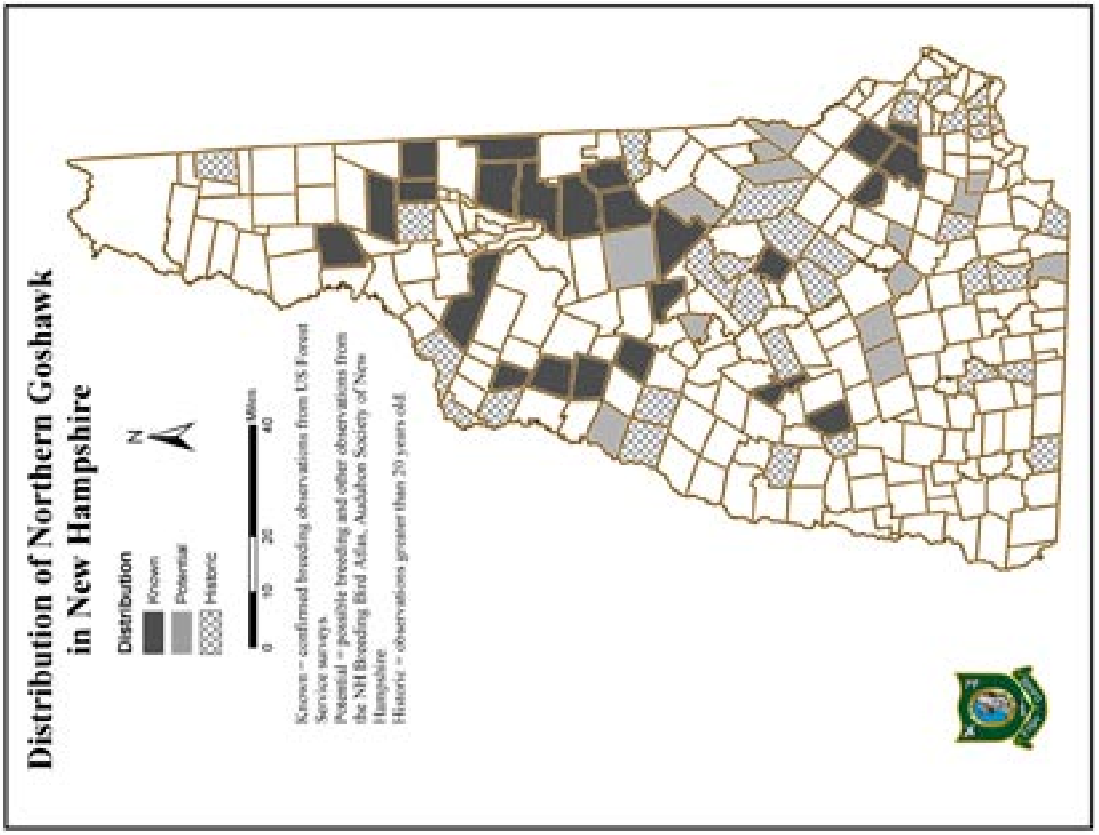

Distribution of Golden Eagles
in New Hampshire
Distribution
Potential
Historic
N
0 10 20 40 Miles
Potential = possible breeding and other observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Historic = observations greater than 20 years old.

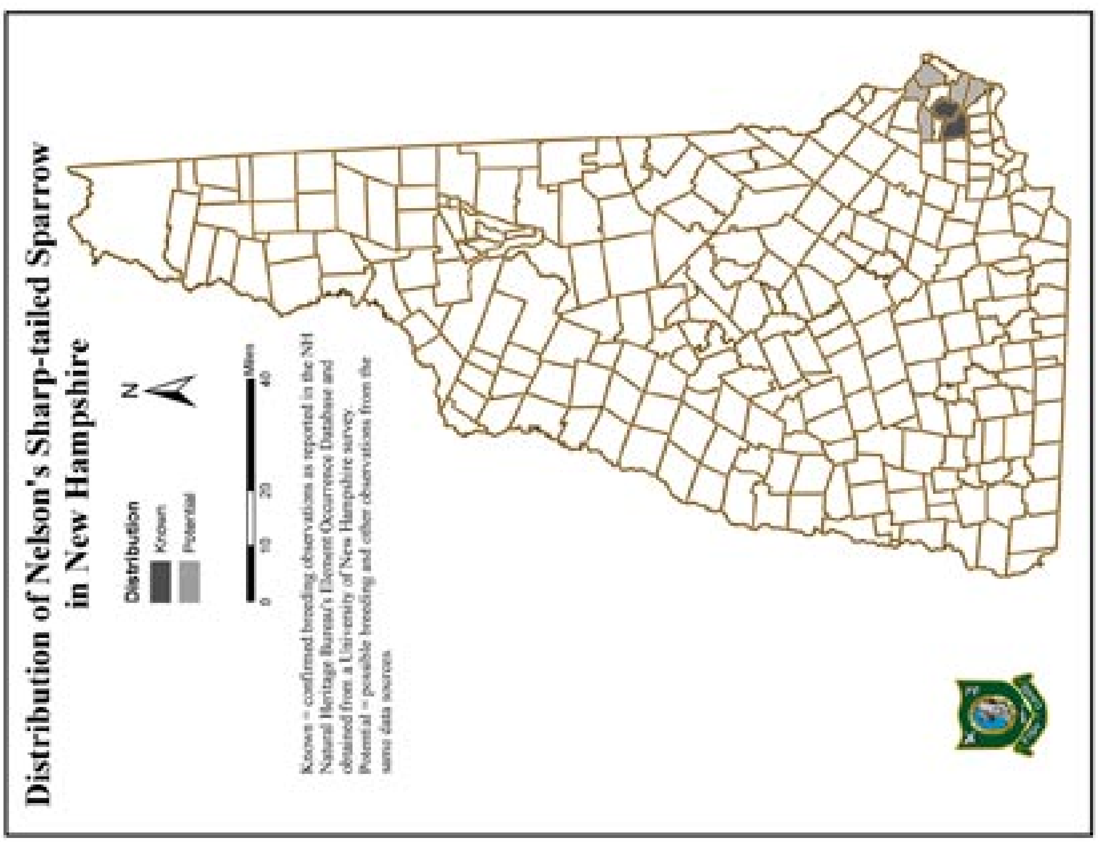

Distribution of Grasshopper Sparrow
in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40
Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.

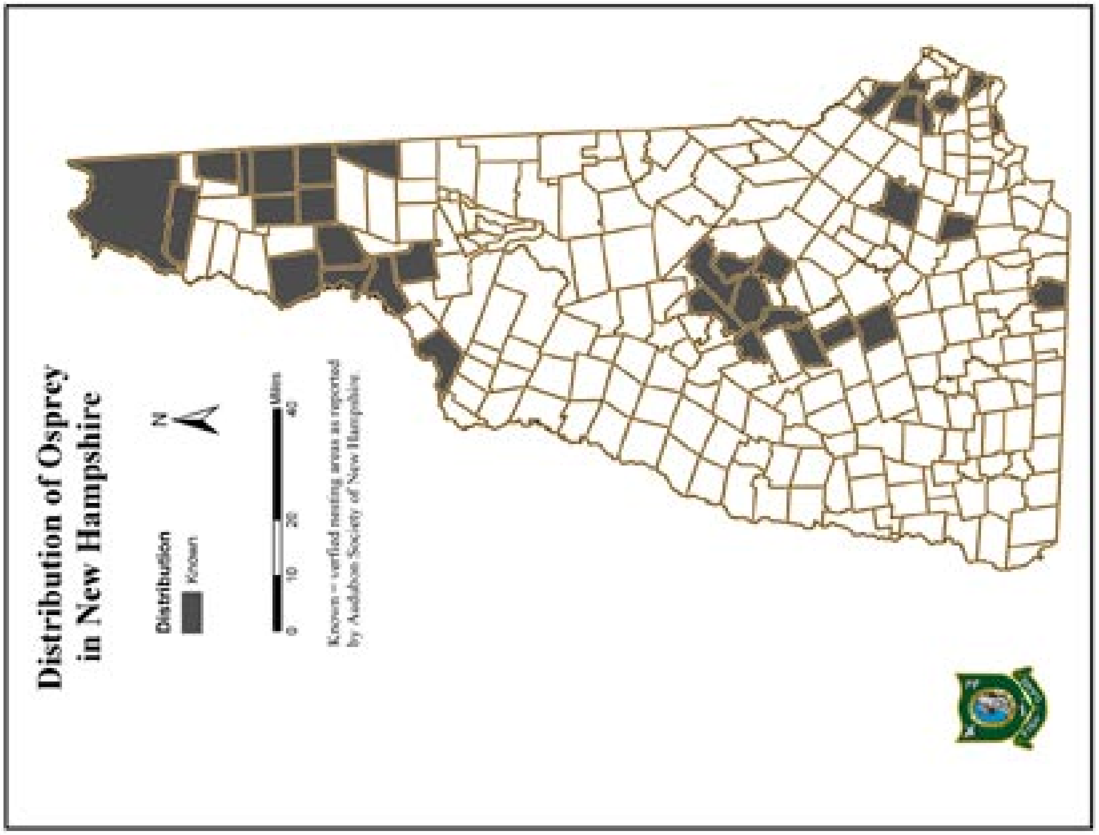

Distribution of Great Blue Heron Rookeries
in New Hampshire
Distribution
Known
N
0 10 20 40
Miles
Known = confirmed locations of rookeries as reported in the NH Natural Heritage Bureau's Element Occurrence Database.

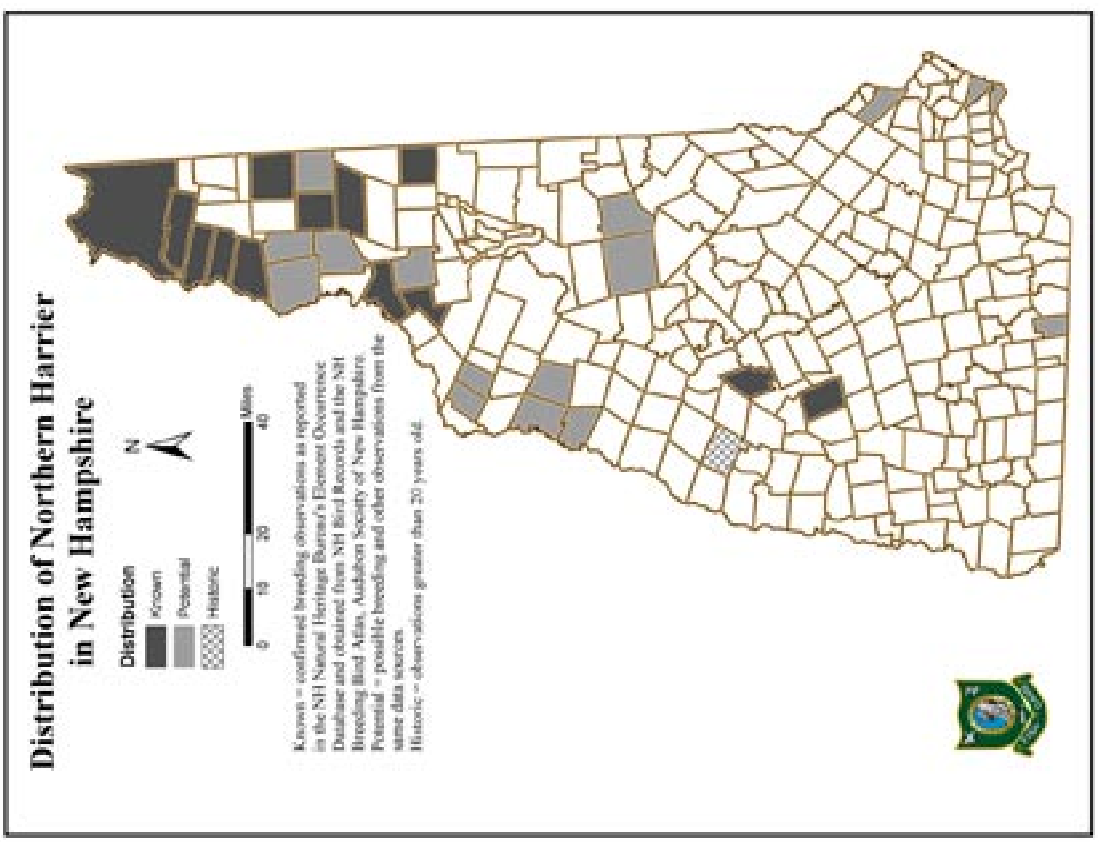

Distribution of Least Bittern in New Hampshire
Distribution
Known
Potential
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.

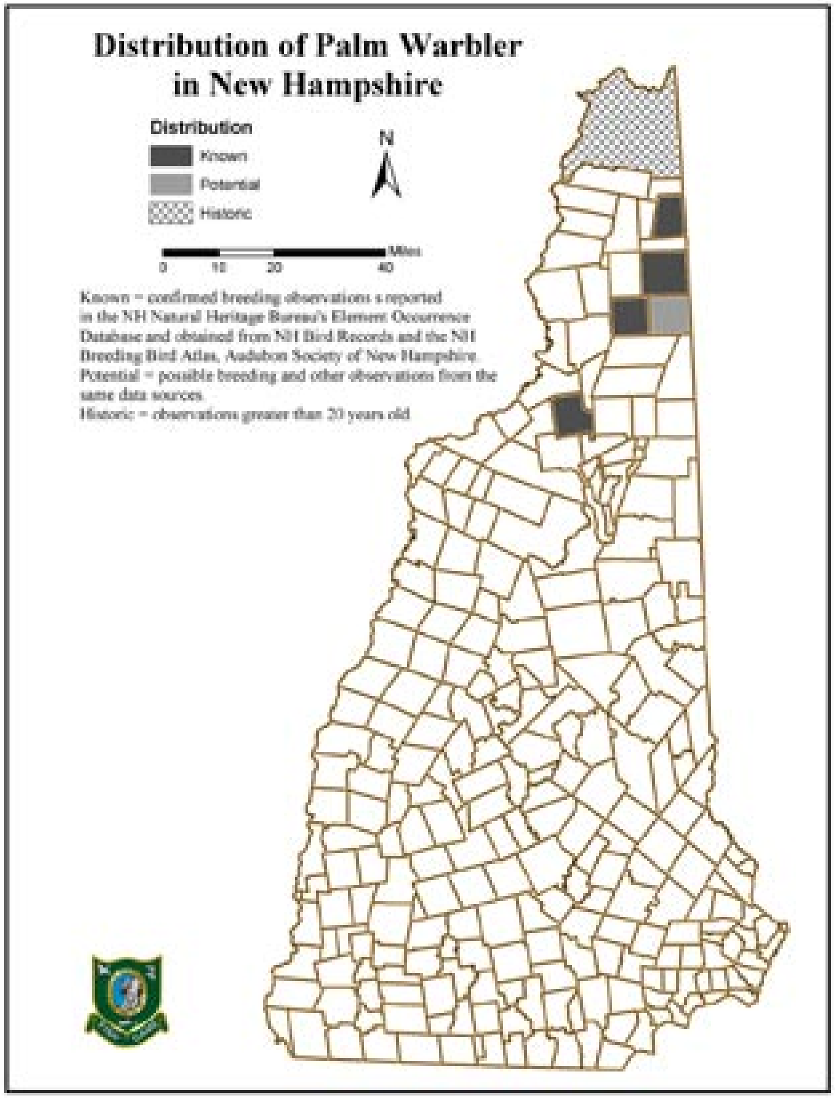

Distribution of Horned Lark in New Hampshire
Distribution
Potential
Historic
N
0 10 20 40 Miles
Potential = possible breeding and other observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.

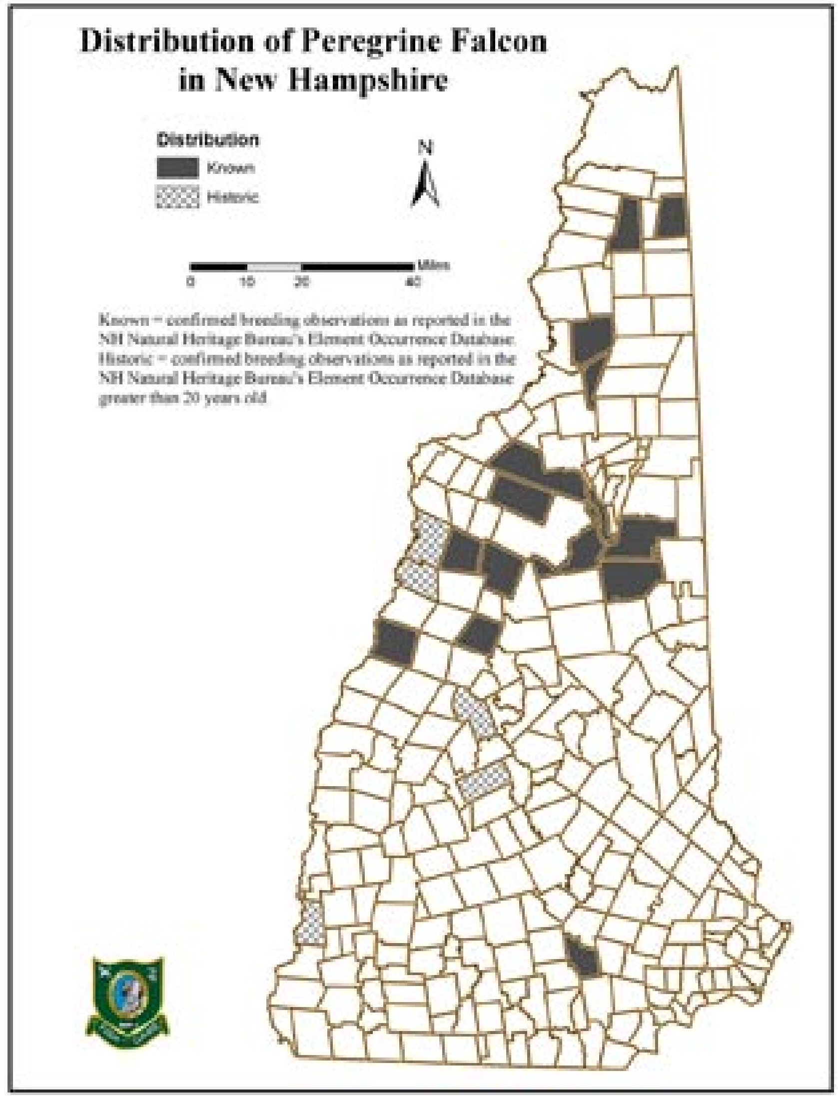

Distribution of Northern Goshawk
in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations from US Forest Service surveys.
Potential = possible breeding and other observations from the NH Breeding Bird Atlas, Audubon Society of New Hampshire
Historic = observations greater than 20 years old.

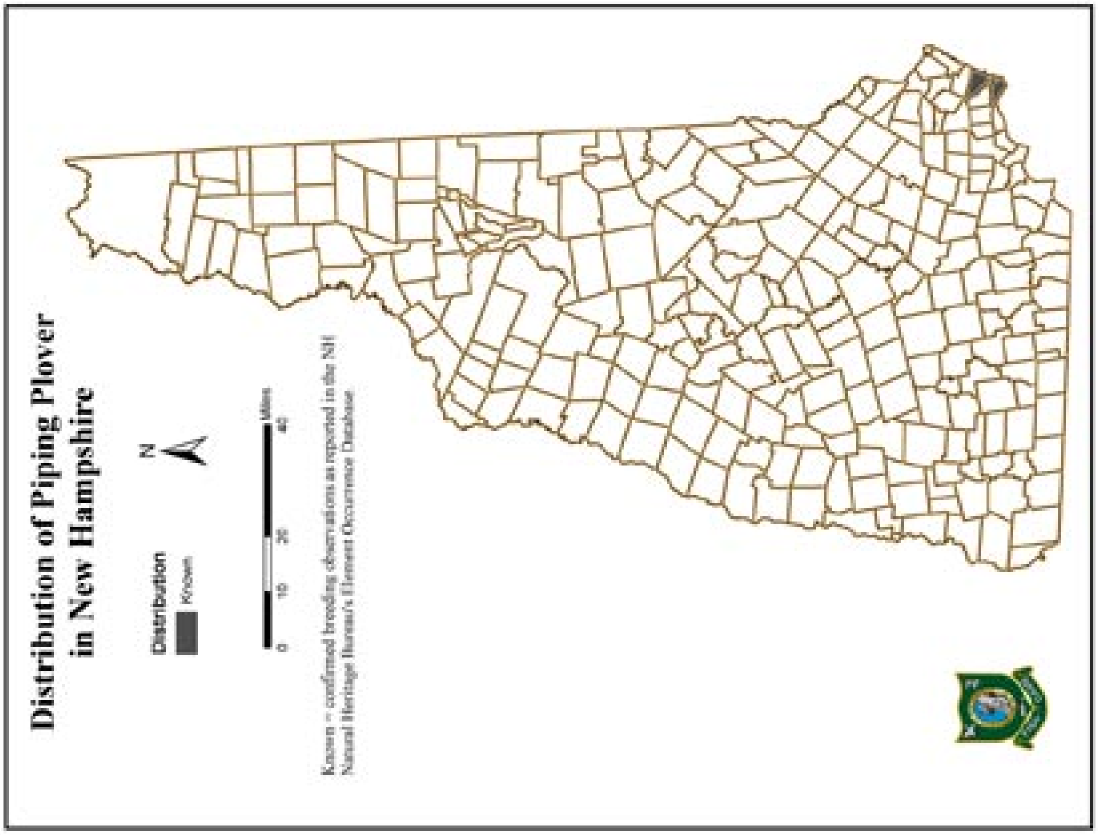

Distribution of Nelson's Sharp-tailed Sparrow
in New Hampshire
Distribution
Known
Potential
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from a University of New Hampshire survey.
Potential = possible breeding and other observations from the same data sources.

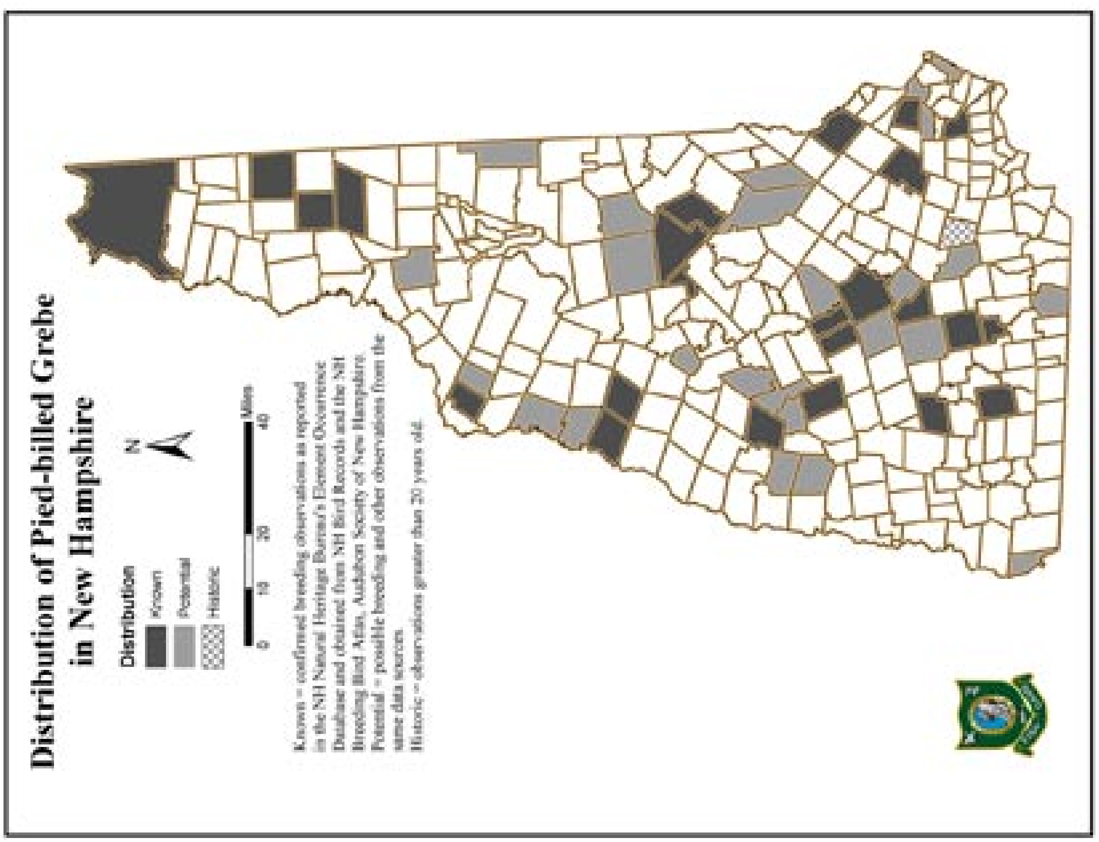

Distribution of Osprey in New Hampshire
Distribution
Known
N
0 10 20 40 Miles
Known = verified nesting areas as reported by Audubon Society of New Hampshire.

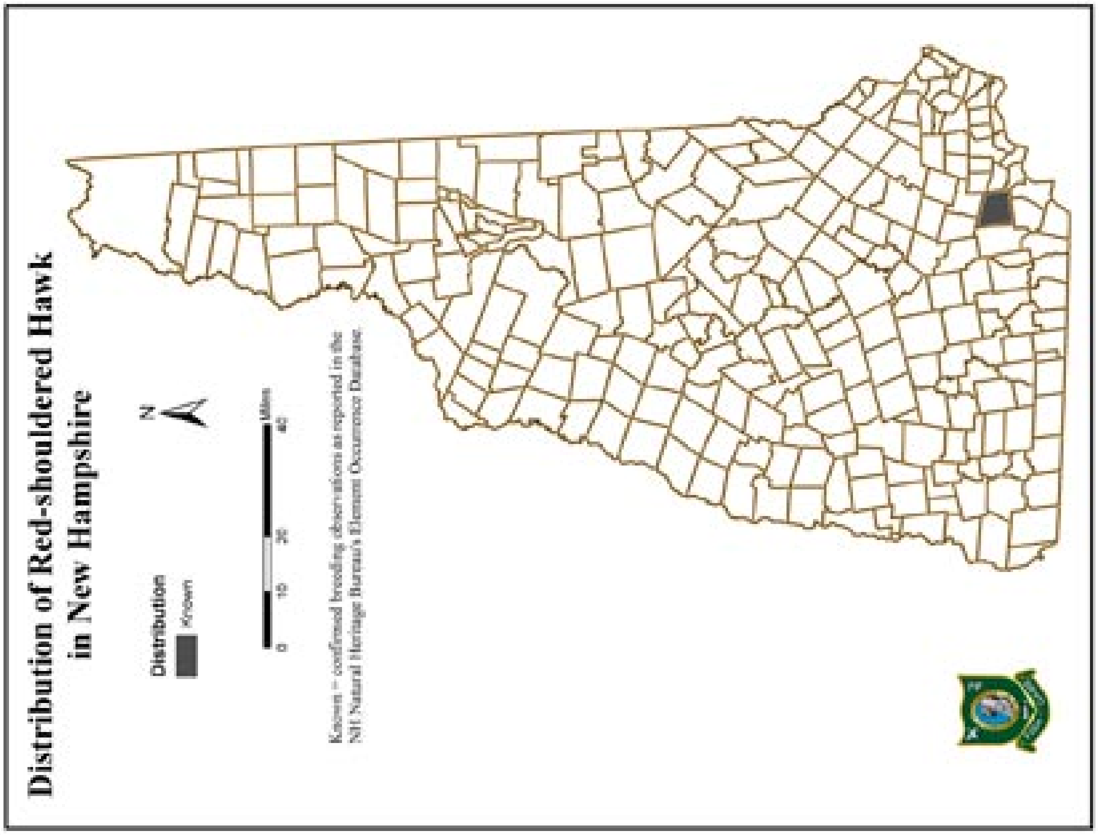

Distribution of Northern Harrier in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.

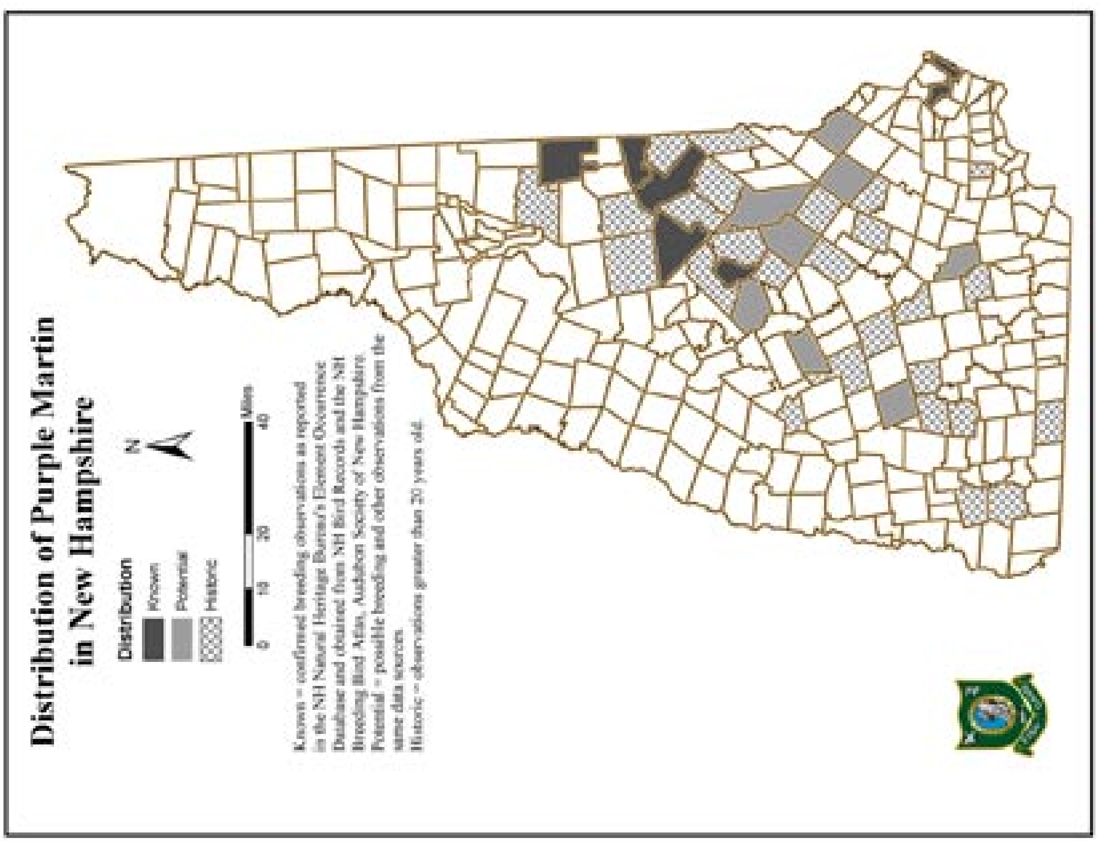

Distribution of Palm Warbler
in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations s reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old

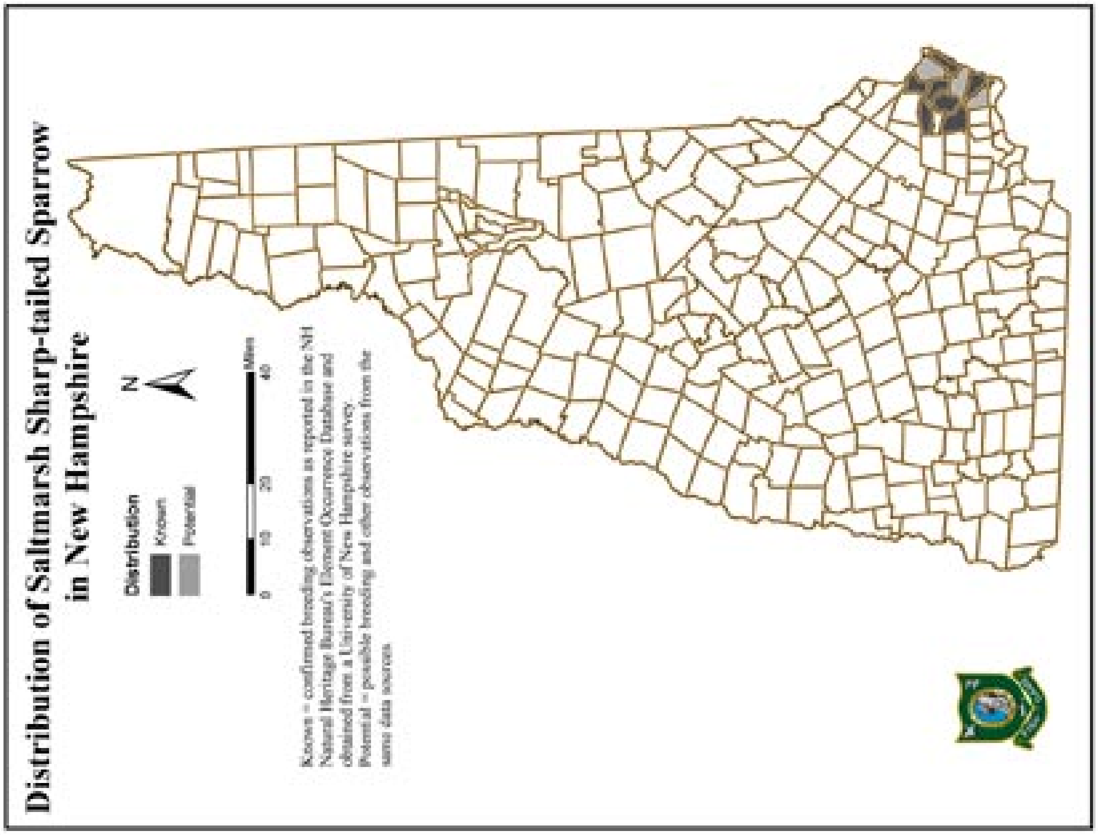

Distribution of Peregrine Falcon
in New Hampshire
Distribution
Known
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database.
Historic = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database greater than 20 years old

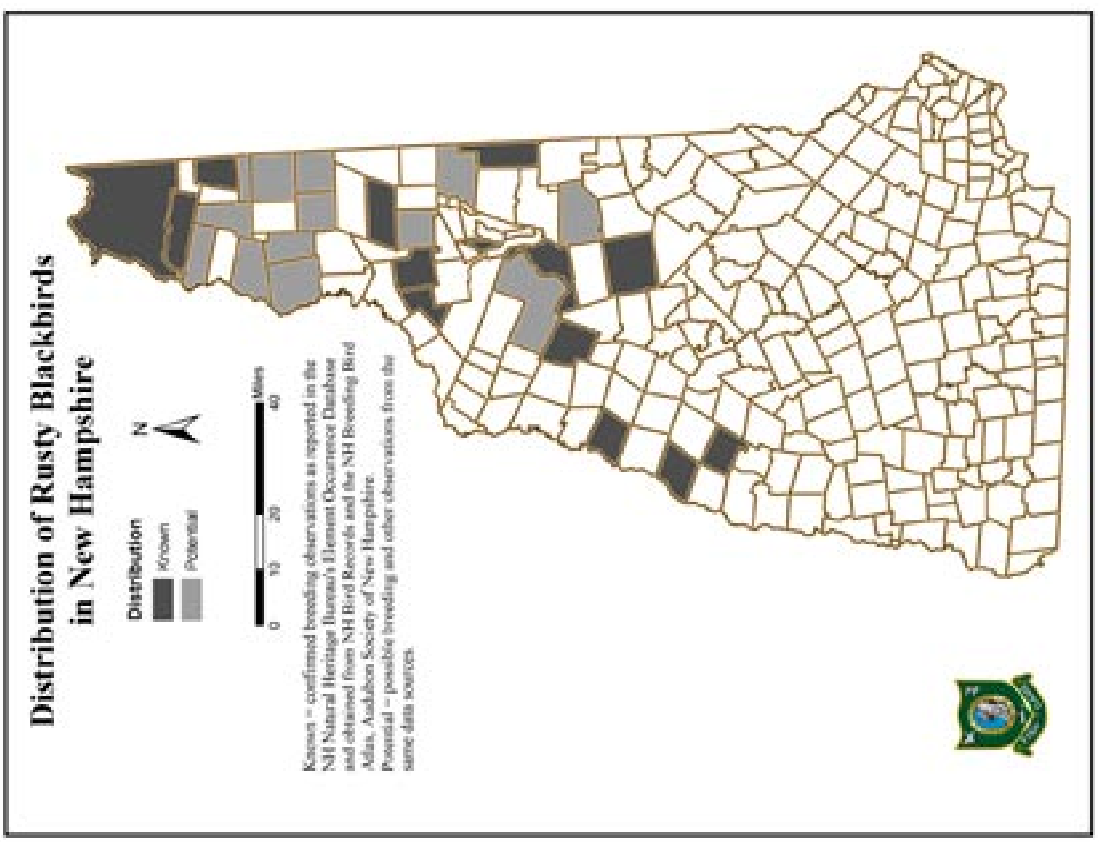

Distribution of Piping Plover
in New Hampshire
Distribution
Known
N
0 10 20 40
Miles

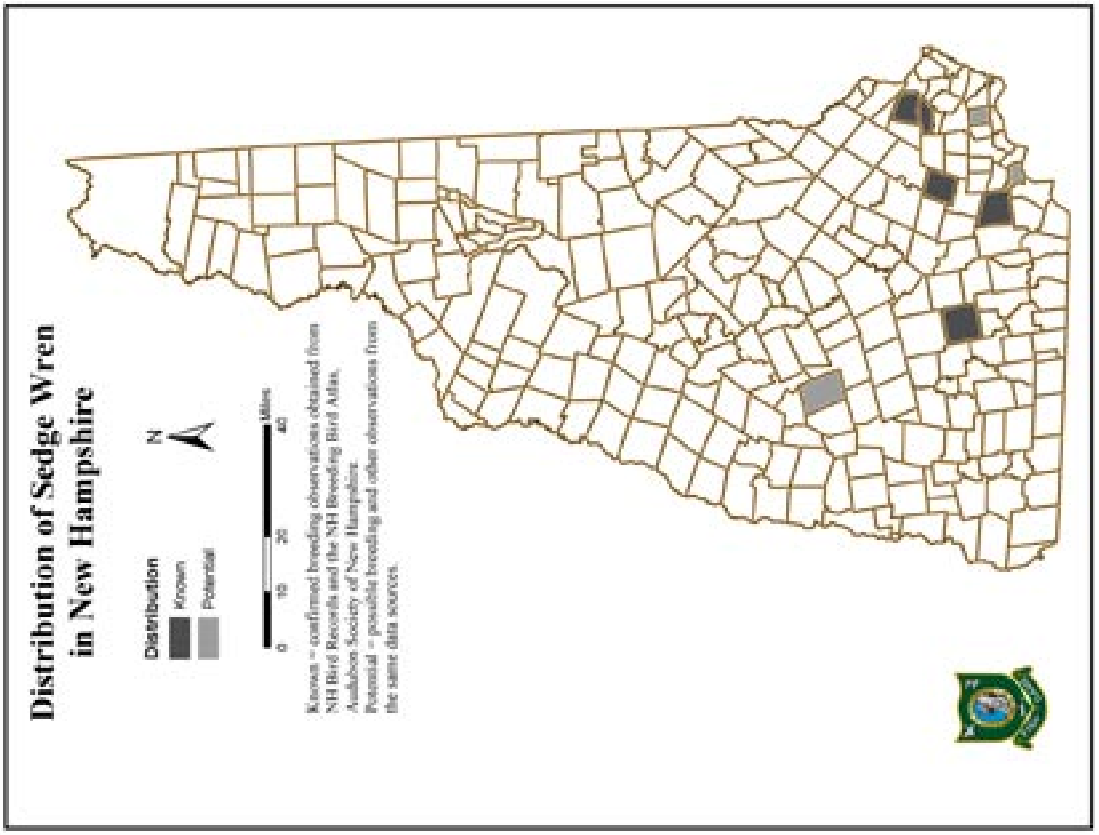

Distribution of Pied-billed Grebe
in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40
Miles

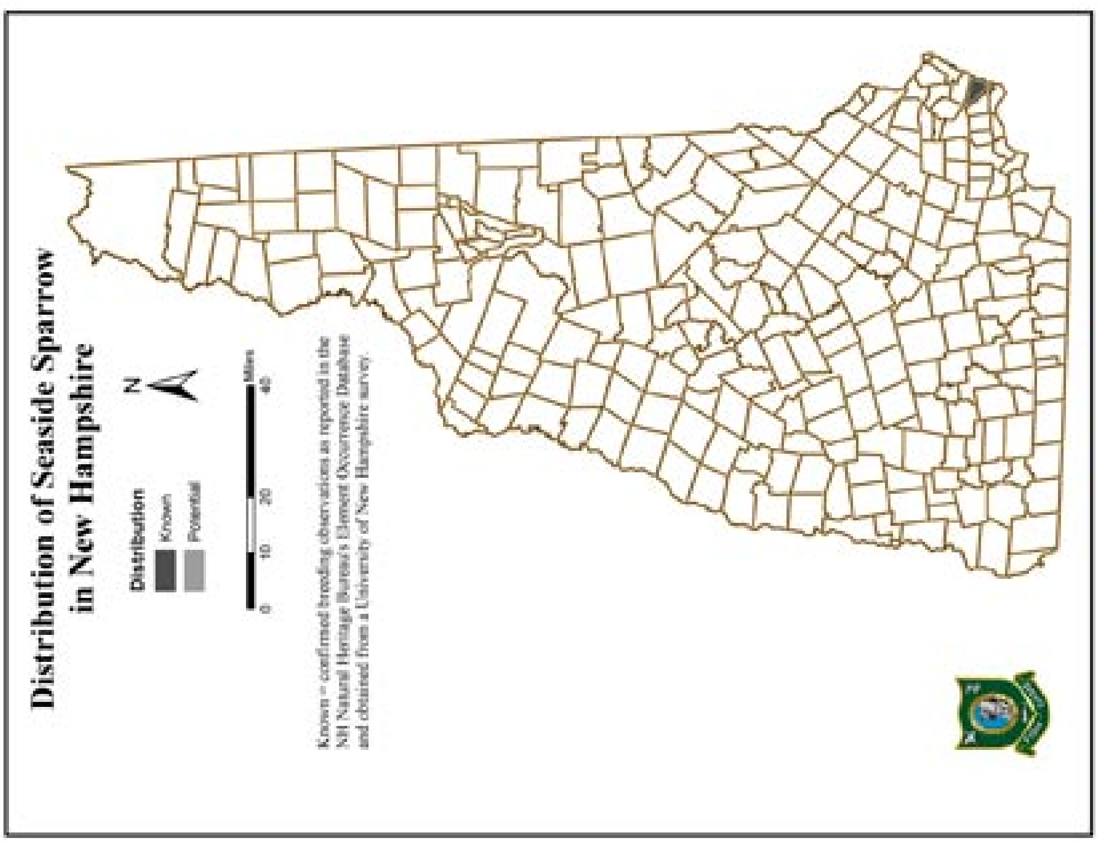

Distribution of Red-shouldered Hawk in New Hampshire
Distribution
Known
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database.


Distribution of Purple Martin in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.

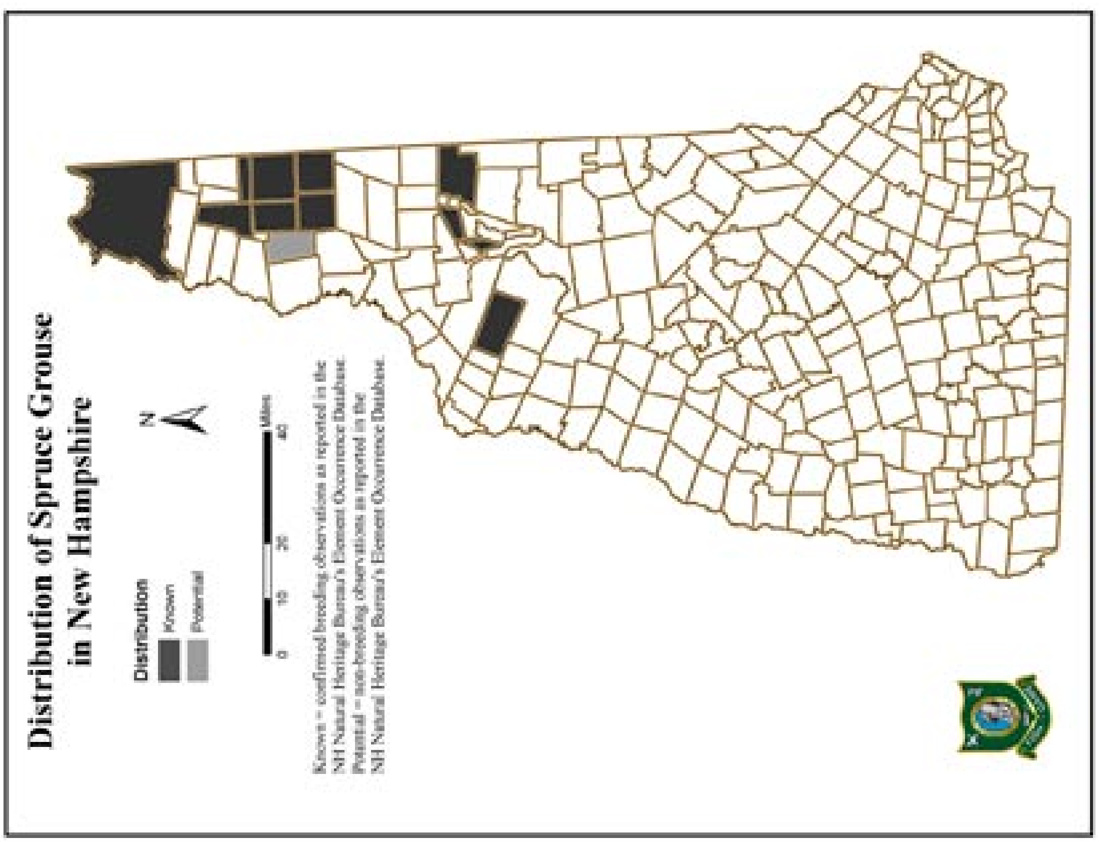

Distribution of Saltmarsh Sharp-tailed Sparrow
in New Hampshire
Distribution
Known
Potential
N
0
10
20
40
Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from a University of New Hampshire survey.
Potential = possible breeding and other observations from the same data sources.


Distribution of Rusty Blackbirds
in New Hampshire
Distribution
Known
Potential
N
0
10
20
40
Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.

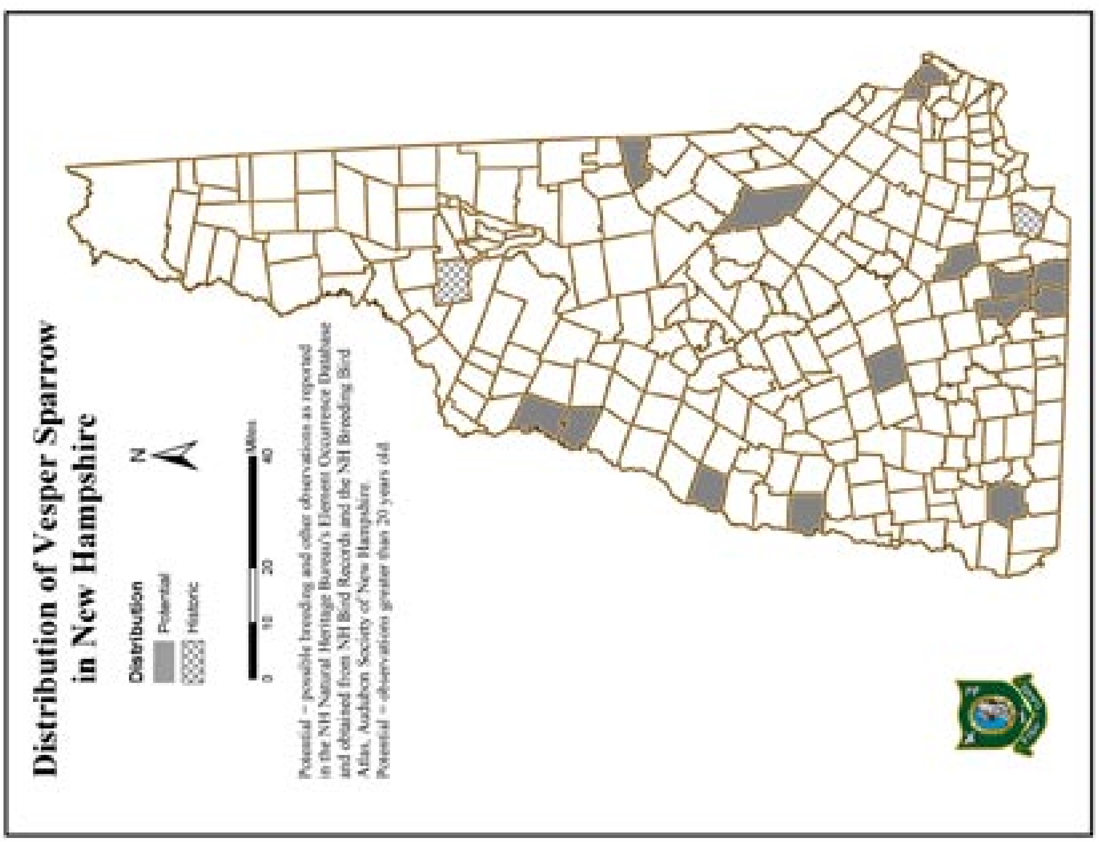

Distribution of Sedge Wren
in New Hampshire
Distribution
Known
Potential
N
0
10
20
40
Miles
Known = confirmed breeding observations obtained from
NH Bird Records and the NH Breeding Bird Atlas,
Audubon Society of New Hampshire.
Potential = possible breeding and other observations from
the same data sources.

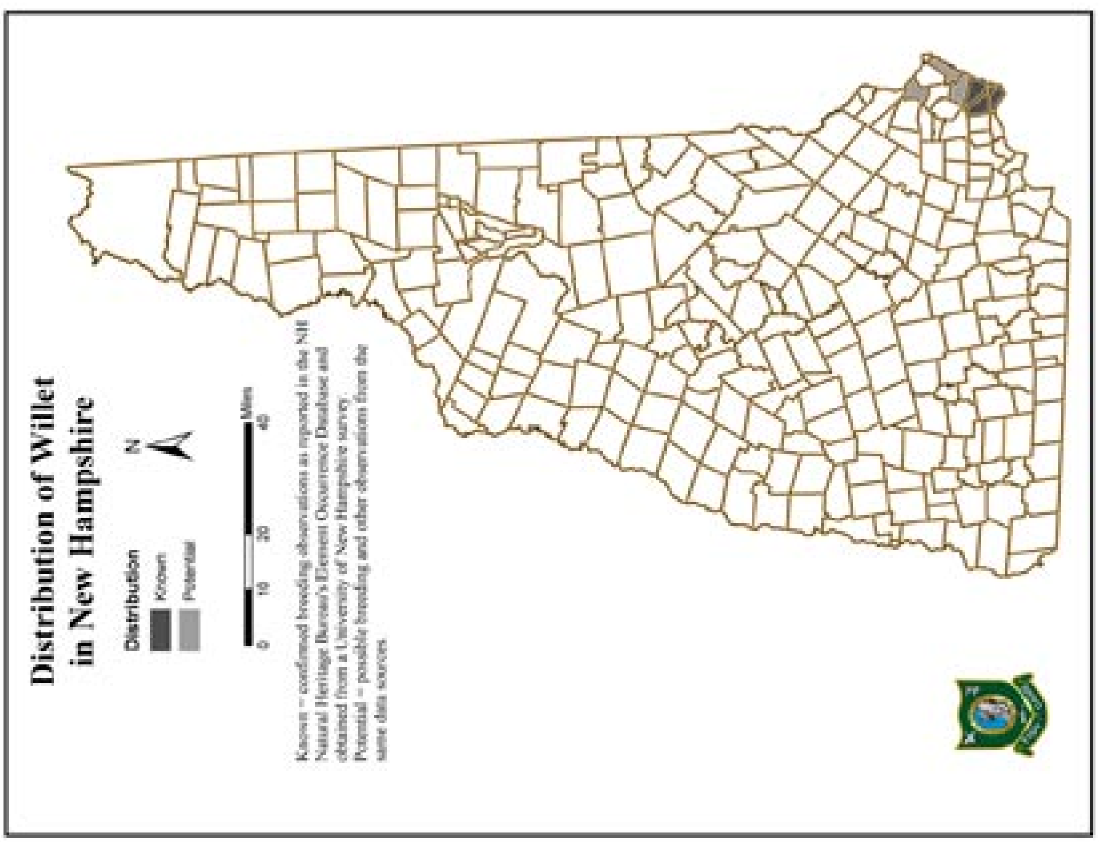

Distribution of Seaside Sparrow
in New Hampshire
Distribution
Known
Potential
N
0
10
20
40
Miles
Known = confirmed breeding observations as reported in the
NH Natural Heritage Bureau's Element Occurrence Database
and obtained from a University of New Hampshire survey.


Distribution of Upland Sandpiper in New Hampshire
Distribution
Known
Potential
Historic
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = possible breeding and other observations from the same data sources.
Historic = observations greater than 20 years old.


Distribution of Spruce Grouse in New Hampshire
Distribution
Known
Potential
N
0 10 20 40 Miles
Known = confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database.
Potential = non-breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database.


Distribution of Whip-poor-will
in New Hampshire
Distribution
Potential
Historic
N
0 10 20 40 Miles
Potential = possible breeding and other observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Historic = observations greater than 20 years old.


Distribution of Vesper Sparrow
in New Hampshire
Distribution
Potential
Historic
N
0 10 20 40 Miles
Potential = possible breeding and other observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from NH Bird Records and the NH Breeding Bird Atlas, Audubon Society of New Hampshire.
Potential = observations greater than 20 years old


Distribution of Willet
in New Hampshire
Distribution
Known
Potential
N
0 10 20 40
Miles
Known – confirmed breeding observations as reported in the NH Natural Heritage Bureau's Element Occurrence Database and obtained from a University of New Hampshire survey.
Potential – possible breeding and other observations from the same data sources.